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PROCEEDINGS

OF THE

THIRTEENTH ANNUAL MEETING

OF THE

ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

22

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1902.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., December 3, 1901.

SIR: I have the honor to transmit herewith the manuscript of the Proceedings of the Thirteenth Annual Meeting of the Association of Economic Entomologists, which was held at Denver, Colo., August 23 and 24, 1901. From the fact that the papers presented at the meetings of the Association are always of great economic importance, the Department has hitherto published the secretary's reports as bulletins of this Division; I therefore recommend the publication of the present report as Bulletin No. 31, new series.

Respectfully,

L. O. HOWARD, *Entomologist.*

Hon. JAMES WILSON,
Secretary of Agriculture.

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THIRTEENTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

MORNING SESSION, FRIDAY, AUGUST 23, 1901.

The Association met in room No. 3, Denver High School Building, Denver, Colo., at 10 a. m. August 23, 1901.

The following members were in attendance at the sessions:

William H. Ashmead, Washington, D. C.; Lawrence Bruner, Lincoln, Nebr.; E. D. Ball, Fort Collins, Colo.; A. N. Caudell, Washington, D. C.; Richard S. Clifton, Washington, D. C.; T. D. A. Cockerell, Mesilla Park, N. Mex.; E. M. Ehrhorn, Mountainview, Cal.; E. P. Felt, Albany, N. Y.; C. P. Gillette, Fort Collins, Colo.; A. D. Hopkins, Morgantown, W. Va.; W. J. Holland, Pittsburg, Pa.; L. O. Howard, Washington, D. C.; W. D. Hunter, Washington, D. C.; Vernon L. Kellogg, Stanford University, Cal.; W. M. Scott, Atlanta, Ga.

The meeting was called to order by President C. P. Gillette, who announced that the absence of Secretary A. L. Quaintance necessitated the election of a temporary secretary. Upon motion of Dr. Howard, W. M. Scott was elected.

After calling Mr. Hopkins to the chair, President Gillette delivered the annual address, which follows:

LIFE HISTORY STUDIES ON THE CODLING MOTH.

By C. P. Gillette, *Fort Collins, Colo.*

Fellow-Workers: It is no small honor that you confer upon Colorado in coming for the first time to the Queen City of the West at the beginning of the new century—the Utopian century for all true scientific thought and the highest human development. Never before have you met so far away from the time-honored centers of learning in the East. To-day we are met at the very feet of the Rocky Mountains and in plain view of their eternal snows, which give freshness to our mountain air and unite the waters that feed the two oceans that wash our shores. You have not come in search of health or pleasure, as many do, but in the interest of science, whose one object is to search out the abiding truths of the Creator, and that branch of science which has for its object to make "two spears of grass grow where one grew before." The object is a most worthy one. May our sessions in this place be marked with an unusual degree of harmony and enthusiasm, which shall cause each to return to his field of labor with a new and deeper interest in his work.

In the address which it became my duty to deliver before this association one year ago I took occasion to emphasize the importance of more life-history study and a greater degree of cooperation in our work. As I exhausted my store of good advice at that meeting, and wish to seem to practice what I preach, I have concluded to offer at this time the results of some life-history studies on one of our longest, if not best, known insects—the codling moth. In this work I have received much kindly assistance from members of this Association and others who have answered my questions, and in some cases have put themselves to considerable trouble to collect data and make observations for me in their several localities.

Probably every member of this Association has been disappointed and surprised many times at finding the lack of positive knowledge in regard to certain portions of the life habits of our longest known insect pests. It is not necessary to discover a new insect, friend or enemy, in order to do good original work of the highest value.

The codling moth undoubtedly causes greater annual loss in Colorado than any other insect, unless it be the two-lined locust (*Melanoplus bivittatus*). Our topographical and climatic conditions, with the plains in the east and the mountains in the west, are extremely varied, and there is a popular opinion among many of our orchardists that the habits of the codling moth in Colorado are not to be compared with the habits of the same insect in the Eastern portion of the country. For these reasons, chiefly, my studies of this insect began, one of the main objects being to determine whether or not there are more broods in the warmer portions of the State, where the tenderer fruits are grown, than in the northern parts and in the East. In some ways this report will be one of progress only, as the work is not completed.

A few years ago we were telling orchardists that the codling moth lays its eggs in the calyces of the apples, and we might have been doing so yet had not Washburn corrected us. We were in error, and the fruit growers know it, and have lost confidence to some extent in the correctness of our statements. They do not know but what we are equally liable to be in error in regard to any other matter regarding the life habits of an insect where our statements seem to them doubtful or mysterious. I can not help wondering if some, yes, many of us, have not been equally careless in our statements as to the number of broods of the codling moth in our several States. It is often easier to accept the opinion of another than to verify its correctness. To be a thorough scientist one must be a good doubter, or at least questioner and thinker. Not always gainsaying the statements of others, but always ready to inquire into the basis of belief even of the most stereotyped ideas.

Riley,[1] knowing there existed a difference of opinion as to the number of broods of the codling moth in different portions of the country, made a special study of the insect in Missouri, and announced,

[1] Third Missouri Rep., p. 103.

in 1872, that "At all events this insect is invariably double-brooded in the latitude of St. Louis," and expressed his doubts of its being single-brooded in New England. The year following Le Baron,[1] in speaking of the codling moth, says, "It is universally double brooded at the West; at least, in all parts of the State of Illinois and farther south." In recent years we have had the number of broods estimated by different entomologists, in various parts of our country, all the way from one to four, with variations in the form of "partial broods" thrown in. In fact it has almost become the custom to announce that in one's locality the codling moth is one-brooded with a partial second, or two-brooded with a partial third, and even three-brooded with a partial fourth. So far as my experience has gone, the insects with which I have had to deal have been very uniform in the number of life cycles through which a species passes during a year, and I recall no instance in my experience where an insect normally possessed an annual or otherwise regular fractional brood, and I am unable to find any published data giving strong evidence of such a brood of the codling moth in this country, except that from Dr. Smith, published in Entomological News (Vol. V, p. 284). Dr. Smith was unable for several years in succession to obtain any moths of the second brood in his breeding cages, though wormy apples continued to appear in the orchards in September and October.

In a recent letter from Dr. Smith he states that there is a partial second brood of the codling moth at New Brunswick, N. J., the larvæ of which attack, chiefly, pears of two varieties—Kieffer and Japan Golden Russet. The fact that at least a partial second brood occurs at New Brunswick makes me wonder if two full broods do not regularly occur under normal conditions in the orchard. It is a point upon which we should have more data both at New Brunswick and in other northern apple-growing districts where it has been supposed less than two annual broods occur. Larimer County, Colorado, is at the northern limit of successful apple-growing within the State, yet the codling moth appears to have been regularly two-brooded there during our studies upon its life history for the past three years at least, and I have been able to find no adequate evidence of even a partial additional brood in the warmer valleys in the mountainous districts, where peaches, apricots, nectarines, and the tender varieties of California grapes are grown to perfection. In breeding large numbers of insects of any species it is not surprising to obtain an occasional individual out of season. We have had a very few such instances in rearing many hundreds of the codling moth, but not enough to designate them as a partial brood. For example, three larvæ appeared in our cages before July 15, that remained larvæ over winter. I considered these mere stragglers that in some manner had been prevented from undergoing their life cycle in a normal manner.

[1] Third Rep. State Entomologist of Ill., p. 172.

That there is probable error in some of the announcements as to the number of broods of this insect is further evidenced in the fact that I have received opinions of entomologists of equally good standing in which they estimate the number of life cycles differently by two broods in the same locality. Both can not be correct.

Again, if the codling moth is partial-brooded in a locality, it seems improbable that we should find it uniformly passing the winter in the larval state, yet all authorities seem to agree that such is the case.

HOW TO DETERMINE THE NUMBER OF BROODS.

It is not a simple problem to determine the number of broods of the codling moth where there are more than one. As the insect always winters as a larva, it must be double brooded, at least, if all the larvæ of the first brood of worms feeding in the fruit change to the pupa state soon after leaving the apples. Care should be taken to obtain first-brood larvæ, however, and if they do not change in breeding cages, bands should be left upon the trees for two weeks at least, and then the cocoons opened to see if any contain pupæ. If a good number of larvæ are obtained and none transform under natural conditions, it is fair to conclude that the insect is single brooded in that place. According to my experience the first-brood larvæ will continue to appear for fully one month before those of the second brood will begin to arrive.

The time occupied by the codling moth in passing through its complete round of development during the summer will average about seven weeks. Then if we know when the first larvæ appear in the spring and when the latest ones cease to appear in the fall in a given locality, it will be a very simple mathematical computation to determine a theoretical number of broods for the season, but it will be no evidence whatever that such a number exists, unless we know that all the eggs of a brood are deposited at one time and that all the individuals of the brood run their course at the same rate. We know these conditions never occur in case of the codling moth. The problem we have to solve is one in which many runners are to cover a circular course one or more times; they run at widely varying speeds, and some of the earliest to start will go around once before the late individuals make their start. We suppose all are to cover the course the same number of times, and we are to find that number and also learn whether the number is the same for all. Then what must we know in order to determine our unknown quantities? We must know the beginning and the end of the period during which the insect starts upon its various rounds of development, and we must know the range of time in completing that cycle; then we must know whether those that complete one circuit start upon the next. If one starts upon the course, it goes completely around—at least we know no exceptions to

the rule. Then if the data gathered is sufficient to explain the entire occurrence of the insect for the year, we have no occasion to introduce partial broods. In fact I think their existence should only be announced upon the most positive evidence.

While the data that I have to offer in this address bear chiefly upon the matter of broods of the codling moth, I have not confined myself to that feature of its life history, and shall give such records and observations as I think may be of interest from our studies of this insect.

SPRING BROOD OF LARVÆ AND PUPÆ.

In our early spring studies of this insect we have always found it as a larva in all portions of Colorado. It begins to pupate freely just prior to the blooming of the apple trees, at which time, also, the earliest moths may be taken. The date of pupation varies greatly. Those upon the south side of trees pupate earlier than those upon the north, while others going into the earth about the base of the tree (which many do) or deep into some checked trunk or rotten stump change still later. The time spent in the pupa state by this brood has varied with us from 13 to 68 days, and the time has been as long in the Grand Valley as at Fort Collins.

April 23 of the present year the writer took 285 larvæ and 7 pupæ of the codling moth under bands in an orchard at Fort Collins. May 10, when the early trees were in bloom, he took 33 larvæ and 4 pupæ. From the latter date pupation took place much more rapidly.

SPRING MIGRATIONS OF THE LARVÆ.

I think it was in the spring of 1899 that I was told that a man living near Grand Junction had put bands upon his apple trees in February, and taken many larvæ of the codling moth under them. The following spring I requested parties in Rockyford, Grand Junction, Canon City, Edgewater, and Fort Collins to place at least 10 bands upon trees early in spring, to be examined weekly and report results. From all these bands but 6 larvæ were taken. The past spring I was in Grand Junction when Mr. Silmon Smith was removing bands to catch the migrating larvæ (May 8), and he reported 53 worms from 295 bands remaining on two weeks. I also addressed a letter to Mr. W. H. Barber, of Grand Junction, who it was said had been very successful in taking the larvæ, and he reported taking 307 larvæ April 2 and 409 April 17 from 2,500 bands. So there is a small percentage of the larvæ that seek a new place for pupation in the spring, but the number is usually so small that it seems doubtful if it will often be a matter of economy to attempt to capture them under bands. I can not vouch for the identification of larvæ in the last instance, but if they were all of the codling moth, working the bands must have paid well.

SPRING BROOD OF MOTHS.

At Fort Collins moths have been captured out of doors as early as April 26, long before apple trees were in bloom. Our earliest records for other portions of the State are as follows: Grand Junction, May 7; Canon City, May 5; Rockyford, May 10.

Moths from larvæ brought into the laboratory during April and May have continued to appear in good numbers to June 23 at Fort Collins, and moths have continued to appear in cellar breeding cages to July 24. The early larvæ and pupæ taken at Grand Junction by Mr. Silmon Smith continued to give moths till June 1, those taken at Canon City by Dr. Peare gave moths till June 24, and those taken at Rockyford by Mr. H. H. Griffin emerged till June 8. In none of these cases was any special attempt made to get the latest appearing moths for the locality. The extreme range in time of appearance of the first brood moths in our cages at Fort Collins in 1900 was 69 days.

The following table, giving the dates at which the codling moth appears in its different stages in different parts of Colorado and in some other States, may be of interest for comparison, although there are many blanks that can not be filled at present:

TABLE I.—*Dates of transformations of the codling moth in different places.*

Locality.	Moths of first brood, date of emergence.	Eggs of first brood.		Larvæ of first brood.	
		First.	Most common.	First.	Most common.
Mesilla Park, N. Mex	Apr. 24	May 4		May 31	
Grand Junction, Colo	May 7	May 18		June 5	July 5
Rockyford, Colo	May 10			June 15	....do
Canon City, Colo	May 5			....do	
Corvallis, Oreg	May 16	June 20			
New Brunswick, N. J				July 20	
Morgantown, W. Va				June 27	
Ithaca, N. Y	May 3	June 26		July 1	
Lincoln, Nebr	May —	June 3		June 20	
Denver, Colo				July 3	July 21
Fort Collins, Colo	May 5	June 9	July 3	June 28	July 25
St. Louis, Mo	May 7			June 23	July 8
Northern Illinois	May 12				

Locality.	Moths of second brood.		Eggs of second brood most abundant.	Larvæ of second brood.		Authority.
	First.	Last.		First.	Most common.	
Mesilla Park, N. Mex	June 26					T. D. A. Cockerell.
Grand Junction, Colo	June 28	Sept. 12		July 23	Aug. 15	Silmon Smith.
Rockyford, Colo	July 5	Sept. 15		Aug. 6	Aug. 20	H. H. Griffin.
Canon City, Colo	[1] July 15	Sept. 10		Aug. 1		R. J. Peare.
Corvallis, Oreg	Aug. 1	Sept. 15				F. L. Washburn and A. B. Cordley.
New Brunswick, N. J						J. B. Smith.
Morgantown, W. Va						A. D. Hopkins.
Ithaca, N. Y						M. V. Slingerland.
Lincoln, Nebr	July 2					F. W. Card.
Denver, Colo					Sept. 5	David Brothers.
Fort Collins, Colo	July 13	Sept. 15	Aug. 12	Aug. 3	Sept. 12	C. P. Gillette.
St. Louis, Mo	[2] July 8			Aug. —		C. V. Riley. [3]
Northern Illinois	July 15					W. Le Baron.

[1] On or before. [2] Estimated by writer. [3] First Missouri report.

DURATION OF SPRING BROOD OF MOTHS.

Of the 12 males kept in breeding cages 2 died on the second day, 3 upon the third, 1 on the fourth, 2 on the fifth, 3 on the sixth, and 1 on the seventh; an average of a trifle over 4 days. Of 7 females 1 died on the sixth day, 3 on the seventh, 2 on the ninth, and 1 on the thirteenth; an average of a little over 8 days. Fully half of the females in breeding cages did not lay eggs at all.

SPRING BROOD OF EGGS.

The starting point of the first brood can better be taken at egg laying than from the appearance of the moths. The moths that appear very early are compelled to wait for oviposition until apples are ready to receive their eggs. The earliest that eggs have been observed at Fort Collins was June 9, 1900. This year they were not found until June 19. They became increasingly abundant until they reached their maximum about July 3, and by July 21 it was almost impossible to find an unhatched egg. By July 27 a noticeable increase had started again, marking the beginning of the second brood.

Professor Cockerell records eggs as early as May 4 at Mesilla Park, N. Mex. At Grand Junction, Colo., I found them in small numbers May 25, 1900, and estimated that they might have occurred as early as the 18th of the month. Slingerland records them on May 26 at Ithaca, N. Y., and Card gives June 3 as the earliest date known to him for the appearance of the eggs in Nebraska. One is not liable to discover the first eggs laid by the codling moth, so it is likely that any of the above dates may be too late for the earliest eggs, and the dates in a given locality will vary in different seasons with the date of the blooming of the apple trees. This is so important a date to have from which to work in studying the life history of the codling moth that I offer the following table, giving the dates at which apple trees bloom in different portions of the country. It is chiefly compiled from answers to letters which I have sent out.

TABLE II.—*Dates at which apple trees bloom in different localities.*

Locality.	Date of bloom.	Informant.
Reno, Nev	Mar. 20–Apr. 10	R. Lewers.
Corvallis, Oreg	Mar. 25–Apr. 5	A. B. Cordley.
Urbana, Ill	Apr. 10	J. C. Blair.
Grand Junction, Colo	Apr. 15–27	C. P. Gillette.
Southern New Jersey	Apr. 20	J. B. Smith.
Columbia, Mo	Apr. 20–May 5	J. M. Stedman.
Blacksburg, Va	Apr. 20–30	J. L. Phillips.
Lafayette, Ind	Apr. 20	J. Troop.
Lincoln, Nebr	Apr. 27–May 2	Lawrence Bruner.
Rockyford, Colo	Apr. 28	H. H. Griffin.
College Park, Md	Apr. 30	W. G. Johnson.
Bozeman, Mont	May 1–5	R. A. Cooley.
Morgantown, W. Va	May 1–10	A. D. Hopkins.
Cornell, N. Y	May 1–10	M. V. Slingerland.
Geneva, N. Y	May 4–17	V. H. Lowe.
Fort Collins, Colo	May 5–15	C. P. Gillette.
Wooster, Ohio	May 8–10	F. M. Webster.
Canon City, Colo.[1]	May 10	R. J. Peare.
Lansing, Mich	May 10–12	L. R. Taft.
Ottawa, Canada	May 10–15	J. Fletcher.
Moscow, Idaho	May 10–15	J. M. Aldrich.
Burlington, Vt	May 15	G. H. Perkins.
Madison, Wis	May 15	E. S. Goff.
Orono, Me	May 20	W. M. Munson.

[1] Evidently a late season.

The time elapsing between the emergence of the moth and the deposition of eggs in the cages has varied between 1 and 9 days, with an average of 6.7 days.

The number of eggs laid in confinement has varied between 2 and 50, and nearly every one has hatched except where males were not confined with the female. Of 65 eggs inclosed in paper sacks upon the trees only 2 failed to hatch. Nearly all the eggs seem to be fertile at Fort Collins, but at the same time there are many more eggshells to be found upon the apples than worm holes in them, which would indicate a large mortality among the small worms. In our counts we have found nearly 90 per cent of these eggs upon the free surface of the apples and the remainder upon the leaves.

CHANGES IN THE EGG DURING INCUBATION.

When the egg is first laid it is of a pearly white color. Later there appears upon it a faint red ring, marking the position of the forming embryo. A day later this ring becomes more distinct and later disappears, and in its stead there is a dark central spot, produced by the black head and cervical shield of the embryo. When the larva leaves the egg the remaining shell appears like a fresh egg, except that it is very flat and along one side the slit from which the larva made its exit can usually be seen. Notes by an assistant, Mr. E. P. Taylor, upon 57 freshly laid eggs show that the red ring appears upon the second or third day after the egg is laid, the disappearance of the ring and the appearance of the dark spot 2 to 3 days later, and the hatching of the egg on the first or second day after the appearance of the dark spot. These eggs were deposited in the breeding cages. Eggs observed in the orchard required about 1 day more to hatch, probably on account of the lower temperature during night, making the average incubation period 7 and a fraction days. Riley gave this period as from 4 to 10 days, Washburn as 5 to 10 days, and Slingerland as about a week. We have found the time to vary between 6 and 8 days in the laboratory where the temperature ranged between 68° during the night and 75° during the middle of the day. For eggs kept in a greenhouse where the temperature ran to 110° during the middle of the day, the hatching period was 6 days. The records of the hatching of eggs in these two rooms is as follows:

TABLE III.—*Comparison of egg-hatching records in a cool and a hot room.*

	Cool room; temperature, between 68° and 75° F.	Hot room in greenhouse; temperature, 110° at midday.
Number of eggs	15	15.
Eggs laid	Aug. 11 (night)	Aug. 11 (night).
Distinct red ring	Aug. 14	Aug. 14.
Dark center	Aug. 17	Aug. 16.
Hatched	Aug. 18 (morning)	Aug. 17 (evening).

Eleven eggs hatched in each of the above lots, the difference in time being from evening one day to morning of the next. The time

in the greenhouse was 6 days and in the cool room 6½ days. The eggs were all laid in a breeding cage upon one apple on the night of August 11.

It would seem from this test that if the temperature of the egg is kept above 68° an increase of temperature will not greatly hasten development.

SUMMER BROOD OF LARVÆ.

Our observations upon the very early larval habits have not differed materially from those made by Card and Slingerland, except that we have not found any indications of their feeding upon the surface of the leaves. The earliest that we have ever taken larvæ of this brood at Fort Collins has been June 28. This year the first capture under bands was July 1. The earliest record at Grand Junction is June 5, and at Rockyford and Canon City June 15; the earliest at Denver July 3. Professor Card's record for earliest larvæ of summer brood at Lincoln, Nebr., was June 20, and Professor Slingerland's for Ithaca, N. Y., was July 1. Dr. Smith wrote me July 20 of this year that the codling moth larvæ were just beginning to descend for pupation at New Brunswick, N. J., and Dr. Hopkins, of Morgantown, W. Va., recently wrote that the larvæ were just beginning to descend there on June 20. Professor Cockerell, in 1897, at Mesilla Park, N. Mex., found larvæ of this brood descending May 31. This is the earliest record known to me. If there are four broods of this insect anywhere in the United States, I am sure it should be at Mesilla Park.

The earliest that we have taken larvæ of the second brood at Fort Collins is August 3. In each of these localities the number of larvæ which will live over winter as such increases rapidly in a few days after the above dates. At Grand Junction pupation practically ceases by August 10, at Rockyford by August 20, at Canon City by August 21, and at Fort Collins by August 30 (see Table IV).

TABLE IV.—*Table showing proportions of larvæ, taken at different dates, that live over winter before pupating.*

Locality.	Dates larvæ were taken.	Number taken.	Number hibernating.	Record by—
Grand Junction, Colo.	July 16–23, 1900	33	1	Silmon Smith.
	July 24–30, 1900	53	3	
	July 31–Aug. 6, 1900	60	8	
	Aug. 6–13, 1900			
	Aug. 13–20, 1900	79	78	
	Aug. 21–29, 1960	130	130	
	Aug. 30–Sept. 4, 1900	192	192	
Rockyford, Colo.	Aug. 1–6, 1900	22	5	H. H. Griffin.
	Aug. 7–11, 1900	14	4	
	Aug. 12–14, 1900	51	14	
	Aug. 15–21, 1900	66	56	
	Aug. 22–28, 1900	115	115	
	Aug. 29–Sept. 6, 1900	80	80	
Canon City, Colo.	July 30, 1899	25	0	Dr. R. J. Peare.
	Aug. 1–13, 1899	70	30	
	Aug. 14–20, 1899	50	44	
	Aug. 21–28, 1899	100	99	

Mr. David Brothers, of Edgewater, near Denver, published the record of his captures of codling moth larvæ in his orchard during the

summer of 1900 in a Denver daily about January 15, 1901. I have a clipping only, and do not know the exact date that it was published, nor the paper in which it appeared. The record is as follows:

TABLE V.—*Larvæ taken under bands by David Brothers, Edgewater, Colo.*

Bands removed.	Worms taken.	Average per day.
July 4–6	200	
July 15–17	997	90
August 2–3	747	42
August 12–14	213	21
August 22–24	602	60
September 4–6	2,225	171
September, last week	2,315	*a* 88

a Approximately.

The following record, kept by an assistant, Mr. Titus, at Fort Collins last year, gives approximately the same dates at which the two broods of larvæ reach their maximum and minimum numbers. The dates run a little later at Fort Collins, which is the more northern point. The larvæ were taken twice a week by Mr. Titus, so some of the periods are 3 and some 4 days.

TABLE VI.—*Records of codling moth larvæ taken under bands.*

[Eleven trees in Harris orchard, Fort Collins, Colo., 1900.]

Tree.	July.			August.								September.								October.		
	25	28	31	4	7	11	15	18	22	25	28	1	5	8	12	15	18	22	29	4	7	13
10	1	1	0	1	0	0	1	0	0	1	1	0	3	9	17	4	4	4	5	4	1	0
13	0	0	0	0	7	0	1	0	0	0	0	0	5	12	20	2	6	4	9	5	1	4
14	16	0	1	0	0	1	0	0	0	0	0	3	5	5	19	10	6	4	8	4	0	3
17	9	11	0	8	0	0	0	0	0	1	1	6	15	8	28	8	9	6	9	7	1	0
18	2	0	0	4	0	0	0	0	0	0	0	0	10	20	19	6	12	8	9	5	1	0
19	3	0	0	1	0	0	0	0	0	0	0	8	9	9	21	14	12	6	2	9	0	2
20	1	0	0	8	6	0	0	0	0	0	1	0	6	5	10	4	4	2	12	3	1	0
21	1	3	0	4	0	0	0	1	0	0	0	4	13	11	4	0	4	6	4	1	4	6
22	0	1	0	0	0	0	0	0	0	0	7	9	24	14	28	5	8	4	14	12	3	5
23	6	0	0	9	0	0	0	0	0	0	0	0	2	1	3	0	5	5	9	9	2	6
24	0	0	0	4	0	0	0	0	0	1	0	0	6	8	7	5	5	4	13	0	2	0
	38	16	1	39	13	1	2	1	0	3	10	30	98	102	176	58	75	53	94	59	16	26

The first brood had reached its maximum when the bands were removed the first time, July 25. The great number of ciphers between August 11 and 22 indicate the division between the broods. The second maximum came September 12, and then the numbers diminished rather slowly for the next two weeks.

Another record kept the same year on a tree growing in the college lawn at Fort Collins gave a similar record, though the first maximum came a few days later. The record is as follows:

TABLE VII.—*Codling moth larvæ from bands on tree in college lawn.*

	June.	July.				August.				September.				
	29	7	14	21	28	4	11	18	25	1	8	15	22	29
Larvæ	2	1	10	8	14	24	18	115	84	87	216	464	390	38

The total number of larvæ taken under the one burlap band upon the above tree growing in closely cut grass ground was 1,481. We did not take so large a proportion of the larvæ from any tree growing upon well cultivated ground.

WHEN THE LARVÆ COME DOWN.

To determine what proportion of the larvæ leave the fruit during the bright daylight and what proportion at night to go in search of a place to spin up, I bandaged a tree that I passed each morning and evening and removed the larvæ at about 7.30 a. m. and 6 p. m. from August 15 to 26. There were 414 larvæ taken, 353, or 85 per cent, of which came to the band during the night, and 61, or 15 per cent, during the day, between the hours mentioned.

DURATION OF LARVAL PERIOD.

Dr. Riley[1] gave this period as 25 to 30 days outside the cocoon, Washburn[2] as about 4 weeks, Card[3] as apparently 10 to 14 days, and Slingerland[4] estimated the time at 20 to 30 days. In our records the time has varied between 12 and 24 days, with an average of 19, at Fort Collins.

WHERE THE LARVA ENTERS THE APPLE.

Unsprayed trees should be chosen to determine this point. There is also danger of error if the examination of the apple is superficial, as I have found that the larva often enters at the calyx, leaving no castings in sight, and then burrows out at the side some distance away, the latter burrow being kept open, but not the former. An examination of 526 apples wormy by the first brood gave the following results: Two hundred and sixty-seven apples were wormy at the blossom only, 18 at the stem only, 84 at the side only, and 157 had wormholes at the blossom and also at some other place. Adding this last number to the first, we have 424 out of 526 apples, or 80 per cent, with wormholes at the blossom end. The apples counted were of three varieties of crabs.

DURATION OF COCOON STAGE OF FIRST SUMMER BROOD.

The period elapsing from the time the larva leaves the apple or appears under a band to the time the moth emerges I have designated as the cocoon stage. The time elapsing before changing to the chrysalis Riley[5] found to be 3 days. During the present summer (1901) Mr. Taylor has carried through observations for me upon 76 larvæ which transformed to moths, for the purpose of determining the average time

[1] Fourth Mo. Rep., p. 22.
[2] Bul. 25, Or. Exp. Sta., p. 5.
[3] Bul. 51, Nebr. Exp. Sta., p. 22.
[4] Bul. 142, Cornell Exp. Sta., p. 23.
[5] Fourth Mo. Rep., p. 22.

of the entire cocoon stage, and he obtained the following results: The shortest time was 13 days, the longest time 23 days, and the average time 16.75 days.

Observations made for me by Mr. Titus in 1900 for the purpose of determining the entire cocoon stage and also the duration of its two periods—as larva and as pupa—gave results which I have tabulated below. His averages for the entire period are somewhat larger than those obtained by Mr. Taylor. It may be partially due to the fact that he was compelled to open the cocoons daily before pupation to determine their condition. This, however, should not affect the pupa stage.

TABLE VIII.—*Time spent by codling moth from beginning of spinning stage to appearance of moth, Fort Collins, Colo., 1900.*

Larvæ taken.	Larvæ pupated.	Moth appeared.	Number.	Total time.	Larvæ taken.	Larvæ pupated.	Moth appeared.	Number.	Total time.
				Days.					*Days.*
July 2	Aug. 3	July 16	1	14	July 8	July 14	July 31	1	23
Do	July 4	July 18	1	16	July 9	July 15	do	1	22
Do	July 6	July 16	2	14	Do	July 16	do	1	22
Do	do	July 22	1	20	July 10	July 14	do	1	21
Do	July 9	July 24	1	22	July 11	July 18	July 30	4	19
July 3	July 6	July 18	4	15	Do	do	July 31	3	20
Do	do	July 20	4	17	Do	do	Aug. 2	3	22
Do	do	July 21	1	18	Do	do	Aug. 1	4	21
Do	July 8	July 22	2	19	Do	July 19	Aug. 2	2	22
Do	do	July 23	1	20	Do	do	Aug. 3	2	23
Do	July 9	July 24	1	21	Do	do	Aug. 4	4	24
July 4	do	July 20	2	16	July 12	July 16	July 30	1	18
Do	do	July 21	5	17	Do	do	July 31	1	19
Do	July 8	July 23	1	19	Do	July 17	Aug. 3	2	22
July 5	do	July 21	1	16	Do	July 19	Aug. 4	1	23
Do	July 9	July 22	1	17	Do	do	Aug. 6	1	25
Do	July 10	July 23	1	18	Do	July 20	Aug. 4	1	23
Do	July 9	do	1	18	Do	do	Aug. 10	1	29
Do	July 10	July 22	1	17	Do	do	do	1	29
July 6	do	July 24	5	18	Aug. 11	Aug. 13	Aug. 30	3	19
Do	July 12	do	3	18	Aug. 13	Aug. 18	Aug. 31	1	18
Do	July 13	July 25	6	19	Do	Aug. 17	Sept. 5	2	23
Do	do	July 26	2	20	Do	do	Sept. 6	1	24
Do	do	July 27	4	21	Aug. 18	Aug. 24	do	1	19
Do	July 14	July 30	3	24	Do	Sept. 6	Sept. 16	1	29
Do	July 18	July 31	2	25	Sept. 4	do	do	1	12
July 8	July 12	July 30	2	22					

The time required for pupation, according to the above record, after the larva comes down from the tree, was, for 1 larva, 1 day; for 6 larvæ, 2 days; for 10 larvæ, 3 days; for 18 larvæ, 4 days; for 15 larvæ, 5 days; for 7 larvæ, 6 days; for 31 larvæ, 7 days; for 14 larvæ, 8 days; for 1 larva, 12 days; for 1 larva, 19 days. The average time was 5.6 days and the range in time from 1 to 19 days. Number of larvæ in the record, 104.

The time spent in the pupa state by the same larvæ was as follows: Four were pupæ 10 days; 2 were pupæ 11 days; 23 were pupæ 12 days; 13 were pupæ 13 days; 24 were pupæ 14 days; 13 were pupæ 15 days; 10 were pupæ 16 days; 7 were pupæ 17 days; 3 were pupæ 18 days; 2 were pupæ 19 days; 1 was pupa 20 days, and 2 were pupæ 21 days. The shortest time in the pupa state was 10 days and the longest time 21 days. The average time was 14 days.

If we combine the stages above given and call the two the cocoon stage, we shall have a record as follows: One moth appeared in 12 days; 3 in 14 days; 4 in 15 days; 4 in 16 days; 11 in 17 days; 13 in 18 days; 18 in 19 days; 7 in 20 days; 10 in 21 days; 12 in 22 days; 7 in 23 days; 8 in 24 days; 3 in 25 days, and 3 in 29 days. This makes the shortest time in the cocoon stage 12 days and the longest time 29 days, and the average 20 days.

Hatching records kept for me by Mr. H. H. Griffin, at Rockyford, and at Grand Junction by Silmon Smith, indicate that the duration of the cocoon stage in those localities is practically the same as at Fort Collins. Riley[1] gives the entire cocoon stage as 15 to 21 days, Washburn[2] as three weeks, and Slingerland[3] as two or three weeks. Aldrich[4] gives the time as a week or more, but greatly dependent upon temperature.

THE SECOND BROOD OF MOTHS.

The time of appearance of the earliest of the second-brood moths is easily determined by hatching them from the earliest wormy apples of the summer. Riley gave this date for the latitude of St. Louis, Mo., as July 8; Le Baron gave it for northern Illinois as July 15; Card, for Lincoln, Nebr., as July 2; Cockerell, for Mesilla Park, N. Mex., as June 26, and Professor Cordley has written me that for Corvallis, Oreg., he finds it to be about August 1. At Fort Collins the earliest bred moth of this brood appeared July 13; at Canyon City, Dr. Peare reports to me that he bred a moth July 15; at Rockyford, Colo., Mr. Griffin obtained the first moth July 5, and at Grand Junction, Mr. Smith obtained a moth on June 28.

The following records for the very latest moths appearing of this brood (or some later brood, as the case may be) are of interest in this connection. The latest moth to appear in breeding cages at Fort Collins came out September 16; the latest at Canyon City, September 10; at Rockyford, September 15, and at Grand Junction, September 12. These are all belated individuals, and all appeared after the general disappearance of the brood. (See Table IV, giving proportions of larvæ that live over winter from different dates.)

THE SECOND BROOD OF EGGS.

I know of no definite published records upon the second brood of eggs. At Fort Collins, this year, this brood seemed to begin its appearance about July 24, and they were most abundant about August 12. The two broods doubtless overlap, but at Fort Collins this year it was almost impossible to find eggs at all from the 20th to the 23d of July,

[1] Fourth Mo. Rep., p. 22.
[2] Bul. 25, Or. Exp. Sta., p. 5.
[3] Bul. 142, Cornell Exp. Sta., p. 27.
[4] Bul. 21, Id. Exp. Sta., p. 101.

and then they began slowly to increase in numbers again. As the first eggs of this year were found June 19, this makes the time between broods about 54 days. On August 20 it was difficult again to find many unhatched eggs.

SECOND BROOD OF LARVÆ.

The earliest that we have taken mature larvæ of this brood at Fort Collins is August 3; at Canon City, August 1; at Rockyford, August 6, and at Grand Junction, July 23, as determined by the dates at which we have first obtained larvæ that did not pupate till spring. (See Table I.) Immediately following these dates the number of such larvæ rapidly increases until none are found except those which remain in the larval state till spring. These last dates, in all our observations, have been taken to mark the close of the appearance of the first larval brood. The dates we have are, for Grand Junction, August 13; for Rockyford, August 20; for Canon City, August 21, and for Fort Collins, August 30. (See Table IV.)

According to our observations this brood passes the winter entirely as larvæ, and begin active pupation at about the time the apple trees begin to bloom.

The pupa stage of this brood usually lasts much longer than that of the summer brood. We have often had pupæ remain 30 or 40 days before the moths emerged, and a considerable longer period has not been very unusual. The longest spring pupal stage that we have recorded is 68 days, March 7 to May 14, at Grand Junction.

THE NUMBER OF BROODS.

While the above data may be weak at some points, I believe it is fairly safe to announce that the codling moth is definitely two-brooded throughout Colorado, with no adequate reasons for postulating a partial brood to account for the belated larvæ that have fallen behind the majority in the race. Let us see if the data we have presented bear out the conclusions.

According to our records the entire life history of the summer brood is divided into periods about as follows: From egg to larva, 7 days; from larva to cocoon stage, 19 days; cocoon stage to emergence of moth, 18 days; emerging of moth to middle of egg-laying stage, 5 days (estimated)—a total of 49 days, or just 7 weeks.

The first larvæ matured in the apples last year at Fort Collins July 3, and we began taking larvæ that lived over winter August 12—just 40 days after. At Canon City Dr. Peare took the first larva June 15, and the first larva that did not pupate was taken 47 days later—August 1. Mr. Griffin, at Rockyford, took the first larva of the summer brood June 15, and the first that lived over winter without changing, 52 days afterwards, August 6. Mr. Smith, at Grand Junction, took the first mature larva last year June 10, and the first to live over winter without pupating, 43 days afterwards, July 23. As the time in each of

these localities approximates the time required for the entire life cycle, according to our records, and as the number of larvæ not transforming until spring rapidly increased from the dates given for the first captured, so that within 20 days thereafter all were of this winter brood, it seems certain that there could not be a third brood in any of the localities mentioned, as there is not room for them. A partial brood from the early maturing second brood could be granted if necessary. Now, if we could find the first brood of larvæ extending late enough to account for the last larvæ that pupate, we should have no need whatever to suppose a partial third brood. This we can not quite accomplish from the data at hand, but we can so nearly cover the period that the few days remaining, in which only scattering specimens are taken that pupate, would, in my estimation, easily be covered by the few individuals that have taken a longer time for development than our breeding records will show, as it is practically impossible in a few breeding experiments to include the extremes of a brood.

In our records larvæ taken from the orchard late in April and transferred to a moderately cool cellar continued to give moths to July 24. This would easily account for eggs to August 4. As the first eggs were found at Fort Collins the same year, June 9, we have the egg-laying period extended over 56 days.

As the first larvæ were taken under bands at Grand Junction in 1900, on June 10, and the last larvæ pupating were taken August 12, these two dates mark the extremes of the brood, provided there is no partial brood. It exceeds the time our records indicate for it by 7 days. The time is so nearly provided for that it seems that a partial brood can only be allowed when proven to exist by actually carrying the insect through the three generations in breeding cages. So while we can not say positively that there is not a partial third brood at Grand Junction, or even Rockyford or Canon City, our records do not prove it, and the writer is strongly inclined to the opinion that it does not exist. A complete third brood can not be accounted for at all. When Mr. Brothers, near Denver, last year collected 2,223 larvæ and only 2 pupæ under bands that had been on the trees since August 24—13 days—he proved very conclusively that only stragglers of the first brood were remaining at that date.

I have not yet received sufficient data to state what the conditions may be in other States. Professor Cordley has recently written me that at Corvallis, Oreg., he has not been able in four years to rear a codling moth later than September 15, and he gives June 20 as the date of the first eggs upon apples that he has been able to find. This makes the period for the broods at Corvallis even shorter than at Fort Collins. He also states that his records "indicate two broods, and two only," at Corvallis. Prof. W. M. Munson, of Orono, Me., also writes under date of August 17, that "some wormy apples placed in boxes August 1 are now yielding pupæ." So there is at least a partial second brood in Maine.

I might deduce further evidence to support the opinions expressed as to the number of broods, but I have already tired you with a long address and many records and deductions drawn from them. The data referred to are included in the present paper. You may study them at your leisure and draw your own conclusions. I only hope that at no distant time we may be able to make definite statements without much guesswork as to the number of broods of this important orchard pest wherever it occurs in this country, and that the observations here reported may assist to that end.

On motion of Dr. Howard, Professor Gillette was voted the thanks of the Association for his excellent address.

A general discussion of the address followed.

Mr. Ball thought that much could be gained from this paper as a lesson upon the magnitude of a complete life-history study, and made a general suggestion that the life history of a closely allied species, living under natural conditions, could often be used as a check to the work on that of an economic species. As an illustration, he cited the case of the chinch bug and the false chinch bug, which have been variously reported as from one to four-brooded, while closely allied species occurring under natural conditions can be easily determined to be definitely two-brooded.

Mr. Howard said the paper was an education upon life-history work, but suggested that the statement that the insect was only double-brooded in the South as well as the North was somewhat startling, and that he was not at all disposed to accept it without further evidence.

Mr. Scott stated that he had done very little work on this insect, but from his general notes it appeared to be three-brooded in Georgia.

Mr. Cockerell thought that the greatest damage was done to September apples, while fruit maturing in June was not materially damaged. It was almost impossible to grow apples in southern Mexico, while the insect did not occur in Arizona.

Mr. Hopkins thought that the moth would be governed by the same phenological law as that which governed the periodical phenomena of plants and other insects—that is (as determined by him in West Virginia), an average difference of about 1 day for each one-fourth degree of latitude and about the same difference for each 100 feet in altitude.

The results of observations made by him in June and July, 1901, is compared with the calculated normals for first appearance of larvæ from apples in West Virginia, as follows:

Locality.	Date of observation and result.	Latitude.	Altitude.	Calculated normal dates.
		° ′	*Feet.*	
Morgantown	July 3, a few had emerged	39 45	1,000	July 1 (estimated base).
Gerrardstown	June 27, a few had emerged	39 30	400	June 24.
Elkins	July 9, a few had emerged	38 45	2,000	July 7.
Leebell	July 10, first emerging	38 40	2,200	July 9.
Huttonsville	July 11, a few had emerged	38 45	2,100	July 8.
Near Huttonsville.	July 11, none had emerged	38 45	2,600	July 13.

Matured larvæ collected at Morgantown on July 3 produced moths on July 16–17. Matured larvæ collected at Elkins July 9 produced one moth on August 9. Therefore he thought that at low southern sections in his State the moth might be two-brooded, while at high northern sections (Canadian zone) a second brood would rarely, if ever, occur. He also was inclined to believe in the three-brooded theory for the South.

Mr. Gillette suggested that it would be interesting for Dr. Hopkins to determine the number of broods of the codling moth in high altitudes as compared with low altitudes in his State.

Mr. Gillette had found it impossible to determine the number of broods with certainty without actually breeding the moths.

Mr. Ball stated that it took an apple a definite length of time to reach maturity and, in his opinion, this would determine the number of broods. The period of development of the fruit being the same North and South, it follows, in his opinion, that the number of broods would be the same.

Mr. Felt, in speaking of the variability of broods, cited the elm-leaf beetle, which has one large brood, with a second brood when the foliage is sufficiently fresh and tender to support it. He asserted that the second generation was produced from the adults of the first brood of larvæ. Trees infested with the second brood of larvæ would furnish adults which may fly to neighboring trees and develop a third generation. There may be, therefore, three well-defined generations under proper conditions.

Mr. Gillette stated that the appearance of late foliage upon the trees could hardly account for the appearance of a third brood of the insects to feed upon them. He did not believe that an abundant food supply would cause the insect to pass through another generation.

Mr. Hopkins stated that it is possible for the number of broods of an insect to vary according to conditions.

Mr. Felt agreed that favorable conditions would produce additional broods. The Hessian fly, for example, according to his notes, produced an additional brood when weather conditions were favorable in late-sown barley.

Mr. Gillette observed that if the codling moth is three-brooded anywhere it seemed as though it should be at Grand Junction, Colo., where the season is long and where there are both early and late apples for the insects to feed upon. Extensive observations in that locality, however, indicate that the insect is definitely two-brooded there.

The following new members were enlisted: James A. Southwick, Providence, R. I., proposed by A. H. Kirkland; A. N. Caudell, Washington, D. C., proposed by W. H. Ashmead.

Mr. E. P. Felt proposed the name of J. J. Burden, Stanley, N. Y., and Dr. James Fletcher proposed the name of Percy B. Gregson, Waghorn, Alberta.

These new names were objected to by Messrs. Ashmead and Hopkins on the ground that the applicants had done no original work in economic entomology, and upon motion of Professor Bruner they were placed on file. In this connection the by-laws touching the credentials necessary for membership were read by the secretary.

President Gillette then announced the following committees:

Program committee: W. M. Scott, E. P. Felt, T. D. A. Cockerell.

Committee on resolutions: A. D. Hopkins, William H. Ashmead, E. D. Ball.

Committee on nominations: E. P. Felt, Lawrence Bruner, William H. Ashmead.

The report of the secretary and treasurer for 1900 and 1901 was read and adopted.

Mr. Felt suggested an annual assessment of 50 cents per member to defray the expenses of the Association. Mr. Ashmead moved that an annual assessment of 25 cents be placed upon all members of the Association. The president ruled both motions out of order, they being contrary to the constitution.

Upon motion of Dr. Hopkins, it was voted that each member present should be assessed 75 cents.

The meeting then adjourned to meet at 2 p. m.

AFTERNOON SESSION, AUGUST 23, 1901.

The meeting was called to order by President Gillette, who announced a paper by Mr. E. P. Felt to be the first on the programme.

THE HESSIAN FLY IN NEW YORK STATE IN 1901.

By E. P. Felt, *Albany, N. Y.*

This pest caused considerable injury in New York State in 1899 and 1900, but the damage inflicted this spring appears, from all accounts, to have been very much greater than in recent years. Wheat passed the winter in excellent condition, and the remark was made in my presence that farmers would hardly have thanked anyone for a guaranty of a full crop, so promising was the situation early in the spring. The season was exceptional, and rains followed each other in quick succession, producing a vigorous growth of all grasses, so that the hay crop was an enormous one. So far as could be learned, there was little indication of the work of this pest last fall, but as the spring advanced the grain suffered more and more, till the latter part of June or early July, when reports of the true conditions of affairs began to come in. Some allowance was made in the case of the earlier reports, because in 1900 the injury was overestimated in some cases, and this may be true in part for 1901, but in some cases it is not. A personal investigation of some of the infested localities has convinced me that many of the reports made to me were literally true. I was shown

a number of fields which to me looked like a rather rough pasture or poorly sown grass, and yet these were pieces which had been seeded with grass and sown to wheat last fall. There was no doubt of the total failure of the grain crop in such cases. These, however, were the worst; all grades of injury could be seen. Fields that escaped without injury were quite few in the regions visited.

This outbreak was utilized to secure some data which may be helpful in understanding the situation. Special reports were received from about 45 fields, located mostly in Erie, Niagara, Genesee, Wyoming, and Onondaga counties, and representing about 760 acres. Of these areas, 90 per cent or more of the grain on 134 acres was estimated as lost, 85 per cent on 58 acres, 75 per cent on 83 acres, 50 per cent on 176 acres, 25 per cent on 63 acres, and 6 to 12 per cent on 248 acres; or, 50 to 90 per cent or more of the grain on 451 out of the total of 762 acres was estimated as destroyed. These reports were not made on badly injured fields alone, but on others as well, and they were made in reply to a series of questions formulated for the purpose of ascertaining so far as possible the cause for this extensive damage. The inquiry developed the fact that a white beardless wheat, known as No. 6, was seriously injured almost without exception, while the bearded red wheat, known as No. 8, escaped with comparatively little harm. None of the above-mentioned reports attributes more than a 25 per cent injury to red wheat, while the white variety ranges from that figure to 99 or 100 per cent destroyed. The white wheat is a much heavier yielder, and is therefore greatly preferred by farmers. This inquiry was started primarily in the hopes of securing data on the date after which winter wheat could be sown with comparative safety. So much grain is grown in western New York, and the fields are so near each other, that it was impossible to secure anything very definite, except that white wheat sown the latter part of September or later was in all probability infested in the spring by flies from overwintered puparia or "flaxseeds."

Some climatic effects were also observed. The continued rains in the spring stimulated the transformation of the flies, and on July 10 a number of fields were seen where the spring brood of the fly had completed its transformation and departed. This was further confirmed by finding several large fields of barley, sown about May 15, badly infested with larvæ and young puparia of this pest. The attacks on the barley were confined largely to the upper, softer nodes, and in at least one field the infestation was very thorough. Every stalk was infested with a few of the pests, and 8 plants taken at random contained from 19 to 54 individuals, most of them being in the larval stage. Curiosity induced me to bring together Weather Bureau records showing the total precipitation and the number of rainy days in the growing months of the fall of 1900 and the spring of 1901. The two localities selected were Alden, Erie County, and Elba, Genesee

County, both in the immediate vicinity of the localities from which my reports were received. The table is as follows:

Month.	Alden, Erie County.		Elba, Genesee County.	
	Total precipitation.	Number of rainy days.	Total precipitation.	Number of rainy days.
	Inches.		*Inches.*	
1900—August	2.48	7	2.39	11
September	3.26	7	2.69	7
October	3.18	7	3.59	8
November	8.42	16	3.99	21
1901—March	3.09	12	.....	.....
April	4.34	11	4.25	10
May	4.49	18	5.13	19
June	1.49	7	3.38	10

It will be seen that last May was very wet, rain falling 18 and 19 days, respectively, in the two localities, and it is no wonder that the spring generation of the fly thrived, completed its transformations, and was ready to infest late-sown barley. The contrast between a rank, succulent growth of the grain and grain injured by the Hessian fly was further shown on one hilly patch of wheat in which there was considerable grain on the gravelly, comparatively dry knolls, while in the more moist gullies the stalks of wheat were very scattering.

In the discussions of this paper, Mr. Ashmead asked what remedy Mr. Felt would recommend.

Mr. Felt replied that late sowing and trap crops plowed under were the most effective remedies.

Mr. Howard suggested the possibility of varieties resistant to the Hessian fly.

Mr. Felt said that No. 8 was said to be resistant.

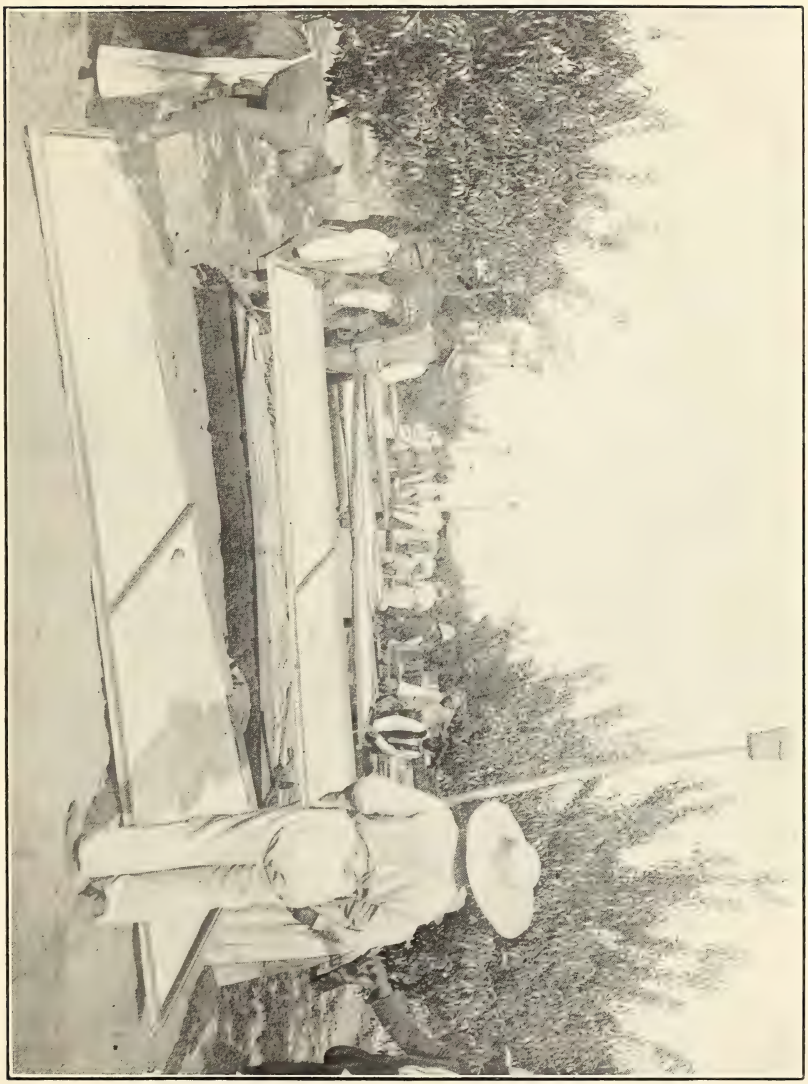
Mr. Scott then presented the following paper:

JARRING FOR THE CURCULIO ON AN EXTENSIVE SCALE IN GEORGIA, WITH A LIST OF THE INSECTS CAUGHT.

By W. M. Scott and W. F. Fiske, *Atlanta, Ga.*

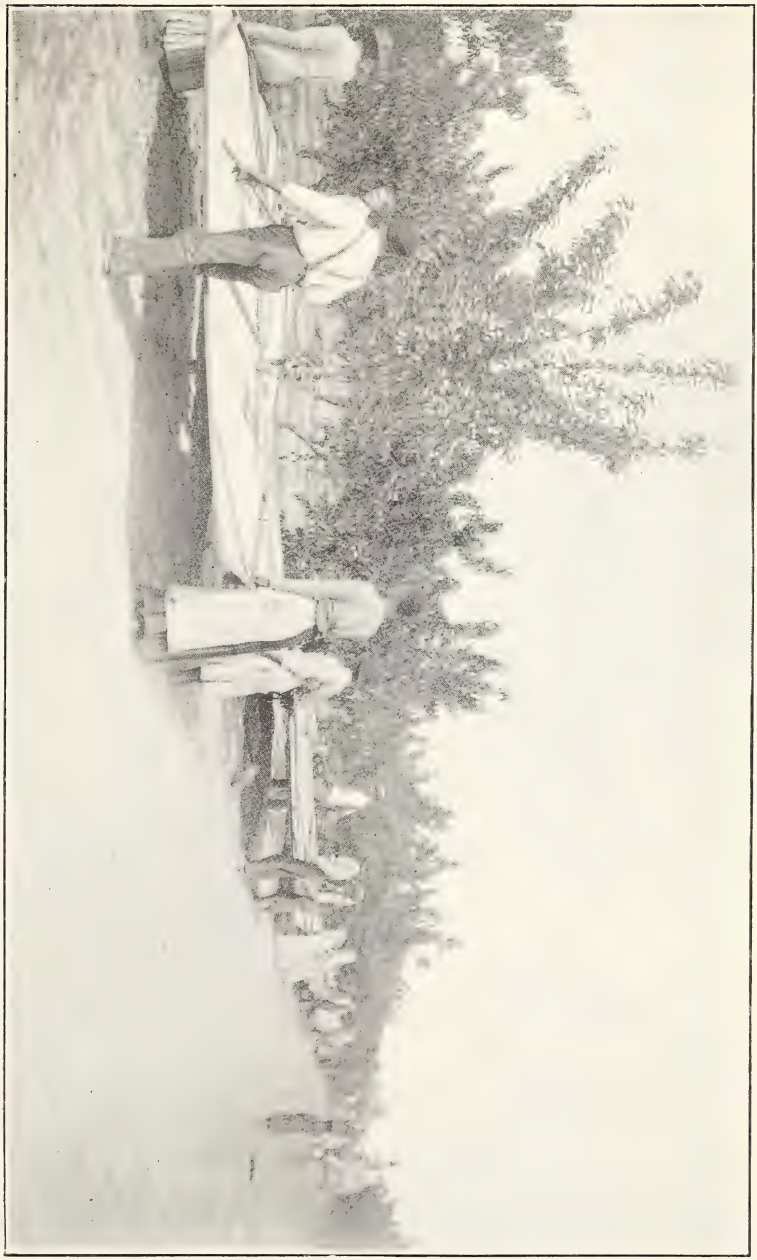
CURCULIO DAMAGE TO PEACHES AND PLUMS.

In Georgia, where peaches and plums are extensively grown for market, perhaps the most perplexing problem that confronts the grower is how to combat the curculio. The San Jose scale, so prevalent in south Georgia, is thoroughly controlled by the kerosene-water treatment, the peach-tree borer is held in abeyance by the cutting-out method, and the brown rot is fairly well controlled with the Bordeaux treatment; but the curculio has succeeded in baffling all contrivances for its destruction, except, perhaps, the tedious and expensive method of jarring the trees and catching the beetles on sheets stretched on frames made for that purpose.



CURCULIO GANG AT WORK WITH SHEETS AND BUMPERS IN ORCHARD AT FORT VALLEY, GA.

From photograph furnished by Scott & Fiske.



CURCULIO GANG AT WORK IN THE HALE ORCHARD, FORT VALLEY, GA.

From photograph furnished by Scott & Fiske.

A conservative estimate would place the annual damage to peaches and plums done by the curculio in Georgia at 25 per cent of the entire crop. Aside from the work of the larvæ in the fruit, the adult beetles are active agents in disseminating the brown-rot fungus, as evidenced by our observations during the past season. In a number of orchards that were sprayed with Bordeaux mixture it was observed that brown rot developed almost exclusively on fruit that had been punctured or eaten into by the curculio, and the point of brown-rot attack was usually at wounds made by the beetles. It is evident, then, that this insect is responsible for considerable brown-rot damage either by actually conveying the spores or by merely breaking the skin of the fruit for their admission.

THE JARRING METHOD IN THE HALE ORCHARD.

Perhaps the most extensive work against the curculio that has ever been undertaken in the history of peach and plum culture was conducted by the Hale Georgia Orchard Company, at Fort Valley, Ga., during the past season. About 200,000 bearing peach trees and 50,000 bearing plum trees were jarred several times between April 18 and June 1. The entire orchard was gone over about six times, while some blocks of trees, particularly those adjacent to woods and other curculio-harboring places, received the jarring every day (except Sundays) between the dates named. The operations were carried on by 11 gangs of 5 hands each. Each gang was supplied with an outfit consisting of two sheets stretched on the underside of light wooden frames, 6 by 12 feet in dimensions, a pole 8 feet long padded with rubber on one end which served as a "bumper," and a supply of baking-powder cans in which to confine the insects captured. Each pair of sheets was carried by 4 women or children, accompanied by a man, who, by forcibly striking the trunk of the tree, effected the jarring.

The several gangs moved through the blocks of trees together, each taking a row, as shown in the accompanying illustrations. About every half hour the sheets were placed on the ground, and all hands engaged in picking off curculio and other insects that looked suspicious. In most cases the lady-bird beetles were allowed to escape.

The jarring was done from 3 a. m. to 9 a. m. and from 2 p. m. until dark. The best results, however, were obtained from the early morning work. With the 11 pairs of sheets about 40,000 trees were thus gone over in a day. (See Plates I and II.)

COST.

It required 60 hands (men, women, and children) to operate the 11 pairs of sheets, and the cost for labor amounted to $25 per day. These gangs of curculio catchers were employed for 37 days, making the total cost for labor $925. Mr. Hale estimated the cost for keeping the outfits in repair at $75, making the total cost for the work of the season $1,000.

RESULTS.

We furnished Mr. J. H. Baird, superintendent of the orchard, with cyanide jars for killing the insects in bulk once a week. As the lots came in they were gone over quite carefully and a collection of the different species occurring therein mounted. These were afterwards determined, so far as practicable, through the kindness of Dr. L. O. Howard, by Messrs. F. C. Pratt and O. Heidemann. Portions of several lots were separated and the curculio counted in order to get at the relative percentage at different times during the season, and at the end of the whole was thoroughly mixed. By counting a definite portion and carefully measuring the remainder a tolerably exact estimate of the total number and percentage was obtained.

The proportions of curculio in the catchings as thus determined varied from 56 to 94 per cent, the average for the entire season being about 67 per cent. The gross number of curculio was in the neighborhood of 137,000.

No attempt was made to determine the percentage of females, but if it be granted that the sexes were equally divided and that each female was capable of depositing 200 eggs an idea can be had of the immense damage that was prevented by the jarring work.

The most important results, however, showed up in the small percentage of curculio-damaged fruit from the jarred orchard as compared with the adjacent orchards that were not jarred. It was quite impossible, of course, to arrive at definite figures, but a fair estimate of the comparative results was obtained by examining both the immature fruit on the trees and the ripe fruit as it came into the packing houses.

In the midst of the shipping season, July 23, we made final notes on the work. The system of sorting the fruit in Mr. Hale's packing house is about as perfect as it can be made on a large scale. One hand sorts for two packers, and all fruit showing curculio damage, rot, or other defect is discarded. Out of one day's shipping of 5 cars, or 2,062½ bushels, there were only 20 bushels of culls, or about 1 per cent. Some damaged fruit is always overlooked and allowed to go on the market. For this we allowed another 20 bushels. In this orchard there was very little premature dropping due to curculio damage, and from our notes we would place this amount of damage about equal with the amount that came into the packing house. A fair estimate, then, would place the amount of curculio damage to the entire crop at 4 per cent.

An adjacent orchard of 130,000 trees was taken as a check. Careful notes made in this orchard and its packing house places the amount of damaged fruit at 40 per cent of the entire crop. The surroundings attending the two orchards are about the same, but it should be explained that the untreated orchard has never received the same clean cultivation that Mr. Hale's orchard is always given.

This would certainly account for a small part of the difference in the percentages of damage in the two orchards.

There seems to be no question as to the successful outcome of the experiment, and Mr. Hale, who shipped 143 cars of fruit from the orchard, considers the money required for the jarring well spent.

A study of the collections of insects made by thus jarring the trees has revealed many interesting features as regards the species present and their comparative abundance. About 325 species were mounted and determined; the larger part were found in insignificant numbers, but many were abundant. Outside of the Coleoptera and Hemiptera, very few of any order were taken, and of these no record has been kept. The presence in considerable numbers of the peach borer, *Sannina exitiosa*, during the early half of May is, however, worthy of note.

LIST OF FAMILIES REPRESENTED.

COLEOPTERA.

The Coleoptera easily outnumbered the Hemiptera, even without considering the immense numbers of curculio, and many of the species were of economic interest. The list of families represented is as follows:

CARABIDÆ.—Very few specimens early in the season, but many at later dates. Lebia, as might be expected, was common; *Calosoma sayi*, *wilcoxi*, and *scrutator* were scarce, but conspicuous from their size and color; Platynus was the most common genus, and represented by several species, of which *limbatus* was present in the largest numbers.

PHALACRIDÆ.—Scarce.

COCCINELLIDÆ.—These beetles, of such great economic importance in reducing the numbers of such widely distributed scales as *Aspidiotus forbesi*, etc., were sorted from the jarrings as made and set at liberty. Thus no good idea could be obtained as to their actual abundance; but, judging from the large numbers that escaped the mercy of the sorters, very large numbers must have been originally present. Thirteen species were identified (counting Scymnus as one), the most of them known as scale feeders. The most common was, however, *Anatis 15-punctata*, with a close second in *Hippodamia convergens*. Among those that have been especially noted as feeding on the scales infesting peach in Georgia were *Coccinella sanguinea*, common; *Chilcorus bivulnerus*, common; *Exochomus tripustulatus*, scarce; *Hyperaspis signata*, scarce. Scymnus was common, but the species are as yet undetermined. Strangely enough, *Adalia bipunctata*, which occurs about plant-lice in swarms, was wholly lacking.

ENDOMYCHIDÆ.—Very rare.

EROTYLIDÆ.—Scarce.

DERMESTIDÆ, NITIDULIDÆ, TROGOSITIDÆ, and DASCYLLIDÆ.—All rare.

ELATERIDÆ.—Abundant. The species, however, largely such as breed in rotten wood, such as the old stumps often occurring in orchards, or in its environs. For instance, *Alaus myops* was common and conspicuous; *Perothops mucida* was very common in some lots, and in general the species were of little economic interest.

THROSCIDÆ.—Rare.

BUPRESTIDÆ.—Abundant. The collections in this family were interesting, principally on account of the abundance of the genus Chrysobothris. *C. femorata*

was very common toward the end of the season; *C. azurea* was equally common throughout, and the same is true of *C. harrisii*. *C. sex-signata* was less so, and a small form that may possibly be a much dwarfed *femorata* was scarce. It seems probable that all of these feed on peach, *femorata* unquestionably so, while *azurea* has been noted from March to July as being a common frequenter of peach trees, especially when old and diseased. About a dozen other species of the family were taken.

LAMPYRIDÆ.—Also a very common family, certain small species of Telephorus being very abundant, arranged according to abundance. Chauliognathus was also extremely common later in the season.

MALACHIIDÆ.—Fairly common.

CLERIDÆ.—Made fairly common by the presence of *Clerus thoracicus* in some numbers.

PTINIDÆ.—Several species, the "twig borer" *Amphicerus bicaudatus* in some numbers.

SCARABÆIDÆ.—The presence of *Anomala undulata* in numbers gave this family considerable prominence that it would not otherwise have possessed. *Lachnosterna* was unexpectedly scarce, though in some variety: *L. tristis* was the only common species.

CERAMBYCIDÆ.—Rivaled only by the Chrysomelidæ for variety, though few species were abundant. *Elaphidion villosum* was common through the season. In all about 40 species were found, and of them a few of the smaller ones were common.

CHRYSOMELIDÆ.—Over 50 species in this family were determined, though many of them were of but occasional occurrence. The flea-beetles were represented by some very prettily colored forms. Perhaps the most interesting economically was *Diabrotica 12-punctata*. This was one of the most common of all the beetles, and is quite injurious to the peach in early spring, eating out the center of the blossoms and opening buds. The potato and sweet-potato beetles found their way in considerable numbers to the slaughter.

BRUCHIDÆ.—Rare.

TENEBRIONIDÆ.—Abundant, represented by some of the more common wood-eating forms.

CISTELIDÆ.—Common.

LAGRIIDÆ.—Quite common.

MELANDRYIDÆ.—Rare.

PYTHIDÆ.—Rare.

MORDELLIDÆ.—Rare until nearly the end of the season.

ANTHICIDÆ.—Species of Notoxus were fairly common, and later in the season these insects are among the most commonly seen on the trees, crawling continually over the leaves for some obscure purpose.

MELOIDÆ.—Rare.

OTIORHYNCHIDÆ.—Rare, except for one species, *Aramigus fulleri*, which in some lots of the catchings was very common, but was far from being uniformly so throughout the season. What its habits may be in this connection is a question.

CURCULIONIDÆ.—*Conotrachelus nenuphar* of course formed a large proportion of the total number of insects caught, but a proportion that lessened as the season advanced, varying from 94 per cent under certain conditions to as low as 56 per cent toward the end of the season. This is in part due, we think, to the fact that much fewer curculio were caught and partly, also, to the increased numbers and activity of other insects. In addition to *nenuphar*, the following species of Conotrachelus were taken: *C. anaglypticus* was common, *C. seniculus*, scarce, and *C. cribricollis*, scarce. All these were noted as being more common during the latter part of the season. Others of this family were conspicuously numerous, as *Chalcodermus æneus*, *Anthonomus scutellatus*, and species of Cryptorhynchus and Baris.

BRENTHIDÆ.—Rare.

CALANDRIDÆ.—*Calandra oryza* was quite common.

SCOLYTIDÆ.—*Scolytus rugulosus* was abundant throughout the season and formed a considerable percentage of the insects outside of curculio.

ANTHRIBIDÆ.—Common, and represented by several species. The rare *Cratoparis lugubris* was not uncommon in one catching, but the individuals received were in a state of decomposition that spoiled them for specimens.

HEMIPTERA—HETEROPTERA.

The Hemiptera were very interesting, embracing as they did insects of quite varying economic status. The number of families at all common were limited, and, strangely enough, the Capsidæ were wholly without representatives. Any one of a dozen species could be selected from the Capsidæ or Pentatomidæ that would outnumber in individuals all the other species of bugs together, saving, perhaps, the Pyrrochoridæ.

CORIMELÆNIDÆ.—Scarce.

CYDNIDÆ.—Rare.

SCUTELLERIDÆ.—Scarce.

PENTATOMIDÆ.—Abundant, including both predaceous and phytophagous forms. *Stiretrus anchorago* was common, with both white and orange ground color and much variety as to detail of markings. Podisus was abundant, but the material has not yet been thoroughly worked over for species. Four or five species of the large flat Brochymena were more or less abundant, especially toward close of season. *Œbalus pugnax* was abundant. Euschistus, the most common genus of all, was represented by *servus*, *tristigmus*, and *crassus* in order of abundance. About 25 species in all were taken in this family.

COREIDÆ.—This family was also abundantly represented and by species of the highest economic importance, foremost among them being large quantities of the leaf-footed plant bugs. Falling in this group were: *Acanthocephala declivis*, common and conspicuous from its gigantic size; *Metapodius femoratus*, to which the same remarks apply: *M. instabilis*, rare; *Leptoglossus oppositus*, abundant; *L. phyllopus*, still more abundant (these two latter species formed 10 per cent of the total catchings in some cases); *L. corculus*, rare; *L.* n. sp., rare. The injury which these insects do in an orchard must be considerable. They sometimes occur in swarms on the trees, flying freely about from one to another, and piercing and sucking green, ripe, and rotten fruit promiscuously. There can be little question but that they thus act as agents in the dissemination of brown rot, and very effectively in a climate so conducive to the development of this disease as Georgia. *Euthoctha galeator*, a species that is oftentimes a serious pest to nursery stock, piercing and sucking the terminal shoot, thus causing it to wither and the stock to branch, was caught in some numbers. *Chariesterus antennator* was abundant, and in all 17 species referable to the family were taken.

BERYTIDÆ.—Rare.

LYGÆIDÆ.—Scarce, on the whole. Several species of Lygæus; one, *turcicus*, fairly common.

PYRRHOCORIDÆ.—Common; represented by *Largus succinctus*.

ARADIDÆ.—Rare.

NABIDÆ.—Rare.

REDUVIIDÆ.—Represented by half a dozen species, all scarce or rare.

HEMIPTERA—HOMOPTERA.

Poorly represented by a few Fulgorids, Jassids, and Membracids, none of them common.

LIST OF INSECTS CAUGHT FROM PEACH AND PLUM TREES IN JARRING FOR THE CURCULIO.

COLEOPTERA.

CARABIDÆ.

Calosoma scrutator Fab. Less rare than *wilcoxi* or *sayi*.
Calosoma wilcoxi Lec. Rare.
Calosoma sayi Dej. Rare.
Pasimachus marginatus Fab. One.
Amara spp. Fairly common.
Calathus opaculus Lec. Common toward end of season.
Platynus limbatus Say. Not found in catchings until end of season, but then abundantly.
Platynus sp. Scarce.
Nemotarsus elegans Lec. Rare.
Lebia viridis Say. Common.
Lebia analis Say. Rare.
Lebia scapularis Dej. Rare.
Philophuga viridicollis Lec. Fairly common.
Chlœnius tomentosus Say. Rare.
Harpalus spp. Fairly common toward end of season.
Anisodactylus rusticus Say. Fairly common toward end of season.
Anisodactylus terminatus Say. Rare.

PHALACRIDÆ.

Olibrus spp. Common.

COCCINELLIDÆ.

Megilla maculata DeG. Abundant.
Hippodamia glacialis Fab. One only.
Hippodamia convergens Guer. Common.
Coccinella affinis Rand. Rare.
Coccinella affinis var. *venusta* Melsh. One specimen only.
Coccinella sanguinea Linn. Common.
Anatis 15-punctata Oliv. Abundant.
Mysia pullata Say. Common.
Psyllobora 20-maculata Say. One specimen only.
Chilcorus bivulnerus Muls. Common.
Exochomus tripustulata DeG. Scarce.
Exochomus pilatii Muls. Scarce.
Hyperaspis signata Oliv. Rare.
Scymnus spp. Common.

ENDOMYCHIDÆ.

Aphorista vittata Fab. Rare.

EROTYLIDÆ.

Languria mozardi Lec. Fairly common.
Languria gracilis Newn. One specimen only.
Tritoma festiva Lec. Rare.
Tritoma thoracica Say. Less rare than *festiva*.

DERMESTIDÆ.

Trogoderma ornatum Say. Rare.

NITIDULIDÆ.

Epurœa labilis Er. Rare.

TROGOSITIDÆ.

Trogosita virescens Fab. Rare.

DASCYLLIDÆ.

Prionocyphon discoideus Say. One specimen only.
Helodes pulchella Guer. Rare.

ELATERIDÆ.

Adelocera discoidea Web. Fairly common.
Lacon rectangularis Say. Common at end of season.
Alaus ocellatus Linn. Rare.
Alaus myops Fab. Common.
Cardiophorus sp.
Elater linteus Say. One only.
Ludius texanus Lec. Common.
Melanotus leonardi Lec. Rare.
Melanotus communis Gyll. Common.
Melanotus sp. I. Common.
Melanotus sp. II. Common.
Limonius griseus Beauv. Common.
Limonius sp. I. One specimen only.
Limonius sp. II. Common.
Sericosomus silaceus Say. Common.
Melanactes morio Fab. Common late in the season.
Perothops mucida Gyll. Common early in the season.

THROSCIDÆ.

Drapetes geminatus Say. One specimen only.

COLEOPTERA—Continued.

BUPRESTIDÆ.

Chalcophora virginiensis Dru. Fairly common.
Chalocophora georgiana Lec. Fairly common.
Dicerca obscura Fab. Common.
Buprestis lineata Say. Several specimens.
Buprestis striata Fab. One specimen only.
Buprestis decora Fab. Several specimens.
Melanophila notata Lap. & Gory. Several specimens.
Anthaxia viridifrons Lap. Rare.
Anthaxia cyanella Gory. Rare.
Anthaxia flavimana Gory. Rare.
Chrysobothris femorata Fab. Common.
Chrysobothris 6-signata Say. Fairly common.
Chrysobothris chrysoela DaCosta. Common.
Chrysobothris harrisii Hentz. Common.
Chrysobothris sp. Several specimens.
Acmæodera culta Web. Rare.
Agrilus sp. Several specimens.
Brachys ærosa Mels. Fairly common.

LAMPYRIDÆ.

Eros humeralis Rand. Fairly common.
Photuris pennsylvanica DeG. Scarce.
Chauliognathus marginatus Fab. Abundant toward the end of the season.
Calochromus perfaceta Say. Common.
Podabrus frater Lec. Common.
Telephorus lineola Fab. Common toward the end of the season.
Telephorus sp. Common.
Telephorus bilineatus Say. Scarce.
Polemius laticornis Say. Fairly common.

MALACHIIDÆ.

Collops eximius Er. Common.
Collops 4-maculatus Fab. Less common than *eximius*.
Tanaops longipes Lec. Scarce.

CLERIDÆ.

Elasmocerus terminatus Say. Fairly common.

CLERIDÆ—continued.

Clerus thoracicus Oliv. Fairly common.
Chariessa pilosa Forst. Rare.
Orthopleura damicornis Fab. One specimen only.

PTINIDÆ.

Ernobius mollis Linn. Common.
Sinoxylon basilare Say. Rare.
Amphicerus bicaudatus Say. Common.

SCARABÆIDÆ.

Canthon probus Germ. Rare.
Canthon praticola Lec. Rare.
Aphodius sp. Rare.
Serica sericea Ill. Rare.
Diplotaxis puberula Lec. Scarce.
Diplotaxis sp. Rare.
Lachnosterna arcuata Smith. Rare.
Lachnosterna fusca Froehl. Rare.
Lachnosterna crenulata Froehl. Rare.
Lachnosterna cognata Burm. Fairly common.
Lachnosterna luctuosa Horn. Fairly common.
Lachnosterna tristis Fab. Common.
Anomala minuta Burm. Rare.
Anomala undulata Mels. Abundant, especially early in the season.
Euphoria sepulchralis Fab. Fairly common toward end of season.
Euphoria fulgida Fab. Scarce.
Trichius piger Fab. Several.
Valgus squamiger Beauv. Rare.
Valgus canaliculatus Fab. Rare.

CERAMBYCIDÆ.

Asemum moestum Hald. Rare.
Phymatodes amœnus Say. Fairly common.
Phymatodes varius Fab. Rare.
Chion cinctus Dru. Rare.
Elaphidion mucronatum Fab. Several specimens in the last catching.
Elaphidion villosum Fab. Abundant. The most common Cerambycid, except possibly *Hyperplatys maculatus*.
Elaphidion unicolor Rand. One specimen only.
Heterachthes ebenus Newn. One of the more common Cerambycids.

CERAMBYCIDÆ—continued.

Ancylocera bicolor Oliv. Rare.
Elytroleptus floridanus Lec. One specimen only.
Batyle suturalis Say. Rare.
Stenosphenus dolosus Horn. Common.
Clytus marginicollis Lap. Only one specimen.
Xylotrechus colonus Fab. Rare.
Neoclytus erythrocephalus Fab. Rare.
Euderces picipes Fab. Rare.
Euderces pini Oliv. Rare.
Rhagium lineatum Oliv. One specimen only.
Acmæops bivittata Say. Rare.
Acmæops discoidea Hald. Rare.
Typocerus zebratus Fab. Not an uncommon species.
Leptura cruentata Hald. Rare.
Monohamnus titillator Fab. Fairly common.
Acanthoderes decipiens Hald. Common in the last catching.
Liopus crassulus Lec. One specimen only.
Liopus variegatus Hald. Rare.
Hyperplatys aspersus Say. Almost as common as *maculatus*.
Hyperplatys maculatus Hald. One of the most common Cerambycids.
Acanthocinus obsoletus Oliv. Rare.
Acanthocinus nodosus Fab. One specimen only.
Ecyrus dasycerus Lec. Several specimens.
Eupogonius tomentosus Hald. Quite common toward the end of the season.
Hippopsis lemniscata Fab. Rare.
Ataxia crypta Say. Rare at first, but more common than *Elaphidion villosum* in the last catchings.
Saperda lateralis Fab. One specimen only.
Tetrops jucunda Lec. One specimen only.

CHRYSOMELIDÆ.

Donacia aequalis Say. One specimen only.
Donacia sp. One specimen only.

CHRYSOMELIDÆ—continued.

Lema cornuta Fab. Rare.
Lema sayi Cr. Rare.
Babia 4-guttata Oliv. Fairly common in the last catchings.
Chlamys plicata Fab. Rare.
Cryptocephalus 4-maculatus Say. Common.
Cryptocephalus 4-maculatus var. *notatus* Fab. Common.
Cryptocephalus sp. One specimen only.
Pachybrachys morosus Hald. Common.
Pachybrachys carbonarius Hald. Rare.
Pachybrachys luridus Fab. Common.
Pachybrachys subfasciatus Hald. Several specimens.
Pachybrachys striatus Lec. Rare.
Xanthonia 10-notata Say. Common.
Glyptoscelis pubescens Fab. Rare.
Myochrous denticollis Say. Rare.
Typophorus canellus Fab. Not common.
Metachroma quercata Fab. Rare.
Metachroma luridum Ol. Rare.
Colaspis brunnea var. *costipennis* Cr. Common toward the end of the season.
Doryphora 10-lineata Say. Rare.
Doryphora juncta Germ. Common at times.
Chrysomela similis Rog. Several specimens.
Chrysomela bigsbyana Kirby. Only one specimen.
Lina lapponica Linn. Rare.
Lina scripta Fab. Common.
Diabrotica 12-punctata Fab. Abundant.
Diabrotica vittata Fab. A few specimens only.
Cerotoma trifurcata Forst. Common.
Blepharida rhois Forst. One specimen only.
Œdionychis thoracica Fab. Common.
Œdionychis vians Ill. Rare.
Œdionychis petaurista Fab. One specimen only.
Œdionychis miniata Fab. Common.
Œdionychis scalaris Mels. Rare.
Disonycha pennsylvanica Ill. Fairly common.

CHRYSOMELIDÆ—continued.

Disonycha caroliniana Fab. Fairly common.
Disonycha discoidea Fab. Several specimens.
Disonycha abbreviata Mels. Fewer specimens than of *discoidea*.
Disonycha 5-vittata Say. One specimen only.
Haltica chalybea Ill. Common.
Haltica ignita Ill. Not nearly so common as *chalybea*.
Haltica rufa Ill. One specimen only.
Crepidodera helxines Linn. Common.
Systena elongata Fab. Several specimens.
Odontota scapularis Oliv. One specimen only.
Odontota dorsalis Thunb. One specimen only.
Odontota rubra Web. One specimen only.
Cassida bivittata Say. Common in the later catchings.
Coptocycla aurichalcea Fab. Fairly common.
Coptocycla guttata Oliv. Fairly common.
Coptocycla purpurata Boh. Rare.
Chelymorpha argus Licht. Rare.

BRUCHIDÆ.

Spermophagus robiniæ Sch. One specimen only.

TENEBRIONIDÆ.

Opatrinus aciculatus Lec. Rare.
Arrhenoplita viridipennis Fab. Rare.
Platydema ruficornis Sturm. Scarce.
Helops americanus Beauv. Common.
Helops cisteloides Germ. Abundant.
Polypleurus geminatus Sol. Rare.

CISTELIDÆ.

Hymenorus obscurus Say. Common.
Hymenorus dorsalis Sz. Common.
Hymenorus sp. I. Common.

CISTELIDÆ—continued.

Hymenorus sp. II. Common toward the end of the season.
Isomera sericea Say. Common.
Capnochroa femoralis Mels. Fairly common in the last catchings.
Chromatia amœna Say. Rare.

LAGRIIDÆ.

Statira gagatina Mels. Fairly common late in the season.

MONOMMIDÆ.

Hyporhagus punctulatus Thom. Rare

MELANDRYIDÆ.

Hypulus (liturata). One specimen only.
Eustrophus tomentosus Say. Scarce.

PYTHIDÆ.

Boros unicolor Say. Rare.

MORDELIDÆ.

Mordella 8-punctata Fab. Common in the last catching.
Mordella sp. Several in the last catching.
Glypodes helva Lec. Scarce.
Mordellistena sp. Scarce.

ANTHICIDÆ.

Eurygenius wildii Lec. Fairly common.
Notoxus nuperus Horn. Fairly common.
Notoxus bicolor Say. Rare.

MELOIDÆ.

Macrobasis unicolor Kirby. Rare.
Epicauta vittata Fab. Rare.

RHINOMACERIDÆ.

Rhinomacer elongatus Lec. Rare.

RHYNCHITIDÆ.

Pteroeolus ovatus Fab. Fairly common.

COLEOPTERA—Continued.

OTIORHYNCHIDÆ.

Pandeletejus hilaris Hbst. Rare.
Aramigus fulleri Horn. Abundant, especially in the early catchings.

CURCULIONIDÆ.

Apion spp. Common.
Pachylobius picivorus Germ. Abundant.
Hylobius pales Hbst. A few specimens only.
Lixus concavus Say. Rare.
Lixus musculus Say. Rare.
Otidocephalus chevrolatii Horn. Rare.
Coccotorus scutellaris Lec. Rare.
Anthonomus scutellatus Gyll. Abundant.
Anthonomus suturalis Lec. Rare.
Læmosaccus plagiatus Fab. Rare.
Conotrachelus nenuphar Hbst. Extremely abundant.
Conotrachelus seniculus Lec. Fairly common.
Conotrachelus cribricollis Say. Not common.
Conotrachelus anaglypticus Say. Common.
Chalcodermus æneus Boh. Common.

CURCULIONIDÆ—continued.

Phyrdenus undatus Lec. Fairly common.
Cryptorhynchus sp. I. Common.
Cryptorhynchus sp. II. Rare.
Baris umbilicata Lec. Rare.
Baris transversa Say.
Baris spp. Abundant.
Trichobaris trinotata Say. Rare.
Madarus undulatus Say. Rare.
Centrinus picumnus Hbst. Rare.

BRENTHIDÆ.

Eupsalis minuta Dru. Several specimens.

CALANDRIDÆ.

Calandra oryza Linn. Quite common.

SCOLYTIDÆ.

Scolytus rugulosus Ratz. Abundant.

ANTHRIBIDÆ.

Toxotropis pusillus Lec. Common.
Anthribus cornutus Say. Common.
Cratoparis lunatus Fab. Common.
Cratoparis lugubris Oliv. Several specimens in one catching.

HEMIPTERA—HETEROPTERA.

CORIMELÆNIDÆ.

Corimelæna unicolor Pal. Beauv. Fairly common.
Corimelæna nitiduloides Wolff. Fairly common.

SCUTELLERIDÆ.

Aulacostethus marmoratus Say. Fairly common.
Aulacostethus simulans Uhl. Fairly common.
Camirus porosus Germ. Rare.
Orsilochus guttatus H. Schf. One specimen only.

CYDNIDÆ.

Pangæus uhleri Sign. Fairly common.
Sehirus cinctus Pal. Beauv. Rare.

PENTATOMIDÆ.

Stiretrus anchorago Fab. Fairly common.
Podisus spinosus Dall. Common.
Podisus modestus Dall. Common.
Proxys punctulatus Pal Beauv. One specimen only.
Podops cinctipes Say. Rare.
Brochymena carolinensis Westw. Rare.
Brochymena arborea Say. Rare.
Brochymena 4-pustulata Fab. Fairly common.
Brochymena annulata Fab. Common.
Neottiglossa cavifrons Stal. One specimen only.
Œbalus pugnax Fab. Common.
Mormidea lugens Fab. Common.
Euschistus servus Say. Abundant.
Euschistus tristigmus Say. Common.

HEMIPTERA—HETEROPTERA—Continued.

PENTATOMIDÆ—continued.

Euschistus crassus Dall. Rare.
Lioderma uhleri Stal. Rare.
Trichopepla semivittata Say. Rare.
Peribalus limbolaris Stal. Common.
Thyantha custator Fab. Common.
Murgantia histrionica Hahn. One specimen only.
Nezara pennsylvanica DeG. Rare.
Nezara hilaris Say. Common.
Banasa dimidiata Say. Common.
Banasa packardii Stal. Less common than *dimidiata*.
Dendrocoris humeralis Uhl. Fairly common.
Dendrocoris fruticicola Bergr. One specimen only.

COREIDÆ.

Chariesterus antennator Fab. Common.
Chelinidea vittigera Uhl. One specimen only.
Corynocoris distinctus Dall. Fairly common.
Archimerus calcarator Fab. Rare.
Euthoctha galeator Fab. Common.
Acanthocephala declivis Say. Quite common.
Metapodius femoratus Fab. Common.
Metapodius instabilis Uhl. Several specimens.
Leptoglossus phyllopus Linn. Abundant.
Leptoglossus corculus Say. Rare.
Leptoglossus oppositus Say. Abundant.
Leptoglossus n. sp. Several specimens.
Anasa tristis DeG. Rare.
Anasa armigera Say. Rare.

COREIDÆ—continued.

Alydus eurinus Say. Rare.
Harmostes reflexulus Stal. Rare.
Corizus punctiventris Dall. Fairly common.

BERYTIDÆ.

Jalysus spinosus Say. Rare.

LYGÆIDÆ.

Nysius angustatus Uhl. Rare.
Ischnorynchus didymus Zett. Rare.
Geocoris borealis Dall. Rare.
Oedancala dorsalis Say. Rare.
Pamera vincta Say. Fairly common.
Dorachosa illuminatus var. *umbrosus* Dist. Rare.
Lygæus turcicus var. *kalmii* Stal. Fairly common.
Lygæus bicrucis Say. Scarce.
Lygæus facetus Say. Rare.
Oncopeltus fasciatus Dall. Scarce.

PYRRHOCORIDÆ.

Largus succinctus Linn. Common.

ARADIDÆ.

Brachyrhynchus granulatus Say. Rare.

NABIDÆ.

Coriscus sordidus Reut. Rare.

REDUVIIDÆ.

Sinea spinipes H. S. Fairly common.
Milyas cinctus Fab. One specimen only.
Zelus luridus Stal. Rare.
Zelus socius Uhl. Rare.
Apiomerus crassipes Fab. Several specimens.
Myodocha serripes Oliv. Several specimens.

HEMIPTERA—HOMOPTERA.

JASSIDÆ.

Homalodisca coagulata Say. Several specimens.
Oncometopia undata Fab. Fairly common.
Oncometopia costalis Fab. Fairly common.
Aulacizes irroratus Fab. Common.

MEMBRACIDÆ.

Tylopelta gibbera Stal. Rare.
Stictocephala festina Say. Fairly common.
Archasia auriculata Fitch. Rare.

FULGORIDÆ.

A single specimen of a large species.

Mr. Ashmead said that it was very gratifying that something was being done with the curculio problem, and he recounted some of the difficulties which attended the attempt toward its control. He mentioned its parasite (*Sigalphus curculionis*, Fitch) and suggested that if it did not already occur in Georgia it be introduced.

Mr. Bruner spoke of the great variety of insects caught, and expressed a desire to see the complete list.

Mr. Hopkins suggested that many of the insects would fly away in the process of jarring, and for that reason all the insects that might occur on the trees would not be taken. He thought that most of the Lachnosterna might thus escape, but that a better explanation of the scarcity of these insects in the catchings was probably in the fact that for some reason they were not generally abundant this season. He also spoke of the interesting relations existing between insects and fungi, as referred to in the paper comparing the curculio and the leaf-footed bugs in their relation to the brown-rot fungus with the mutual dependence between certain Scolytids and the fungus with which they are closely associated, in causing the death and rapid decay of forest trees.

Mr. Scott said that the operation was conducted during the early morning hours when the insects of nearly all sorts were in a semi-dormant condition, and on this account many species were taken which would not have been later in the day. The leaf-footed bugs might be cited as examples, for, though captured in numbers, they are among the most active insects. It would have been possible to have listed many species of Hymenoptera, Diptera, Lepidoptera, etc., but it was not thought advisable because the specimens were in a badly mutilated condition.

Mr. Galloway said that the agency of insects in disseminating brown rot was a point that should be taken into account in the treatment of this disease.

Mr. Howard thought that while cheap labor made the jarring method practicable in Georgia, in the North the higher price for labor might make it too expensive.

Mr. Ehrhorn said that this pest did not exist in California and that the fruit growers there were in great fear of its introduction.

Mr. Gillette said that so far as he knew it did not occur in Colorado, and that they also entertained fears of its introduction.

Mr. Bruner, Mr. Howard, and others, thought it would add much to the value of this paper if it were accompanied by a complete list of the insects taken in the jarring operation, and the writers were requested to furnish the list for publication.

Mr. Ball then presented the following paper:

A SIMPLE FORM OF ACCESSIONS CATALOGUE.

By E. D. Ball, *Fort Collins, Colo.*

This Association has listened in the past to three excellent papers on organization methods in economic entomology, and any State worker at the present time who has not a thoroughly satisfactory system of recording his observations can not do better than carefully study the papers presented on this subject by Dr. Forbes, Dr. Hopkins, and Professor Webster; and if his department has an abundance of clerical help he probably can not do better than to adopt one of these systems. On the other hand, if his working force is somewhat limited the modification hereafter suggested is submitted for his consideration. The author has, however, no intention of offering a system in competition with either of these, but simply of suggesting one or two modifications that can be used in connection with any of these systems or a modified system to be used when it is impossible to carry out a more elaborate one in detail.

The average working force of our stations in economic entomology does not exceed two men, and if the division of salary be any criterion then not over one-third to one-half of their time is devoted to the economic work. Now, under such conditions it would be impracticable to maintain a system of recording requiring the expenditure of any considerable amount of time in the clerical part and at the same time carry on any very extended experimentation, hampered as they are by the ordinary routine of the college work.

Another important factor that may well be considered here is that in this combination of college and station not all collecting is along economic lines, but that one of the duties as a college officer is to build up a systematic collection, an obligation requiring almost endless years of careful and thorough work. Naturally enough this work and that of the station is carried on at the same time, and it would seem that the best system of recording for the smaller stations, and, in fact, for the great majority of our stations, would be that in which the two different objects could be combined, and that with a minimum amount of clerical work, label writing, bookkeeping, etc.

The following system which was experimented with by the author and finally adopted at the Iowa station, and which has been used in the Colorado station for three years, seems to meet these requirements and at the same time furnish a broad enough basis on which to build up any one of the complete systems, if one chooses to do so.

In this system, which may be conveniently called the date system from its fundamental principle, the accession catalogue contains one entry for each trip or special collection, this entry being in the form of a date, giving the year, month, and day; then every specimen as it is labeled up, in place of an accessions catalogue number, as in ordinary way, bears the place of capture and the date on a single small label.

When a collection is made, the first thing to do is to write up the accessions catalogue. To do this, write the date in the left-hand column in figures, the month first, as 6–12, the year being written only once—at the top of each page. In the second column write the locality just as it appears on the label, and in the third column the special locality where these insects were taken. In the next column write the name or simply the initials of the collector. Then for the rest of the width of the page any notes of value on anything taken, as in any other system. I usually here outline the exact trip taken, the stops made, the particular plants collected from, etc., noting as I go along any facts that will add to existing knowledge. In this way if there is anything to record it is written out, and if there is nothing special to note or only facts that have been noted many times before, the simple date and trip note will be sufficient. Oftentimes in this way when the life history or food plant of a species has been made out, a great deal of additional information or confirmation can be gained from these short notes; while any deductions made at that time would probably have been erroneous. A sample form follows:

1901.

6-12	Fort Collins	R. R. south	E. D. B.	*Nysius minutus* found abdt in strawberry bed sucking the juice from the berries as fast as they ripen. They were clustered on a tumble weed (*Monolepis*), which appeared to be their breeding place. On south to altalfa field found *Melanoplus bivittatus* larvæ, small to half-grown, abdt. on margins and ditch banks. Swept Jassidæ and Cercopidæ from *Agropyrum glaucum*. On over to dry pond took Laccocera abdt., both sexes, from dry ground, by fence; also several Lygæids. Coleopt. from willow.
8-3	Durango, Colo.	Up hill east	E. D. B.	Swept *Artemisia 3-dentata;* took short-winged grasshopper, common everywhere, one *Phlepsius* sp. like one from Riffe, three white Anabrus from clumps on hillside. Swept oak: took *Euttettix* sp. near *jucundus* (red) Scaphoideus, Melinna. Swept cedar; took Scaphoideus (white tip), red Platymetopius, a green Eutettix and the pretty n. sp.
8-15	Fort Collins	North 6 miles	C. P. G.	Swept dry ground; took two species of Scolops and Driotura. Small bees from Cleome, Bombus from Helianthus. Typhlocybinæ abdt. on apple.

The labels we print ourselves on a hand press. They are all printed out except the day of the month, and where large collections are made on a given date the entire label is set up. The regular Fort Collins labels are all printed in advance for the season; the others are printed at odd times and as they are needed.

The labels are never over 10 mm. long and 3 mm. wide; the card points are cut with a razor to a uniform length of 9 mm., and the labels are pinned at one end and extend under the card point. On insects that are pinned through the body the labels are pinned so as to extend parallel with the long axis of the insect. In this way it is very rare that a label extends beyond an insect, and never beyond a card point, thus insuring a neat collection.

In referring to the notes the date is used the same as an ordinary catalogue number by looking on top of the page for the year and then down the column for the month and day, which will follow each other in serial order the same as in a series of numbers, and will be found as readily. Having found the date one will always find the exact location and conditions of capture and any other notes thought worth recording at the time.

ADVANTAGES OF THIS SYSTEM.

The main advantage of this system over the others is in the fact that one can collect and record any number of specimens of a species, or any number of species, without materially increasing the labor beyond the mere labor of mounting and labeling any specimen, while in the other systems each individual specimen must have its accessions-catalogue number written out and placed on it, a special entry made in the accessions catalogue for every species, with all of its accompanying records, cross-references, etc., and consequently but few specimens can be mounted in a given time.

Another important factor of utility is in the fact that it is not at all necessary to separate or mount up any of the specimens at the time of capture. All that is necessary is to write up the record, place the locality and date on the package containing the specimens, and it serves the double purpose of an accessions number and the future label. In practice we usually mount the specimens at the time of making the record and then put them away to dry, labeling them up at any convenient time thereafter.

The greatest gain comes from the fact that there is nothing placed on the insect that is not necessary to any well-mounted specimen, i. e., a place and date label, and that nearly all of this label is or can be printed, thus requiring a minimum of hand work.

The fact that this system requires that every specimen be correctly labeled with both place and date will commend it to many persons who have received material for determination from half a dozen different experiment stations bearing nothing more distinctive than a lead-pencil number.

An animated discussion followed the reading of this paper.

Mr. Felt suggested that numerals should not be used to represent months. He thought that less confusion would come from the use of such abreviations as Jr. for January and Mr. for March. His system of note taking required cards, a field book, and an accessions book, each being employed for special conditions and rarely duplicating. He thought he could not adopt Mr. Ball's system to advantage.

Mr. Cockerell said that he used no numbers, and thought that cards were more convenient than record books. In his experience insects

were frequently recorded from localities in which they never occurred, but were so labeled because the owner or collector happened to be there.

Mr. Hopkins said that his system had been modified and improved since it was first announced at the Madison meeting; that he was more than ever convinced of the importance of some well-planned and convenient system, varied according to the special needs and requirements of the individual collector or investigator, by which the necessary collecting notes and original observations may be permanently recorded, so that they will be available and intelligible as long as the specimens and notes may exist.

The records which he considers as absolutely necessary to accompany all specimens are, exact locality, date, collector's name, and if any further notes are made on food habits, life history, descriptions, etc., an unduplicated number (for the species of any given accession catalogue or set of notes) should always accompany the specimens. He said that locality and date labels with collector's name are all right and all that are necessary simply for collected material, but all biological material, and that on which special observations are noted in a book or on a card, should, in order to be of permanent value, bear a number referring directly to a corresponding number of the entry in the book or on the card. To avoid the large numbers which would result from many years of active work, he has adopted a subcharacter or subnumber, or both, to distinguish the many species which may come under the head of one general note; as, for example, the insects collected from a dead pine tree, accession No. 7775 would refer to the general note, while the separate species and their relation to each other and to the trees may be designated by the addition of a letter to the number (7775*a*), which may be extended, as required, from *a* to *z*, and still further extended by double letters, or better by $\frac{a}{1}$, $\frac{a}{2}$, $\frac{a}{3}$, $\frac{b}{1}$, $\frac{b}{2}$, $\frac{b}{3}$, etc., to designate several species found on different parts of the tree, or also the parasites and other natural enemies associated with a given enemy of the plant.

With this system it is not necessary to identify the species in the field, since the individual number will enable it to be identified at any future time or by a specialist, and the name subsequently entered with colored ink in the original note.

He stated that it seemed to him that the permanent usefulness and advancement of economic entomology depended, to a great extent, on accurate and full field notes systematically recorded, so that they will be most available for the individual worker, his assistants, and successors.

Mr. Caudell said that a system almost exactly like that here proposed by Mr. Ball was introduced some two years ago by a writer in the Journal of Applied Microscopy and Laboratory Methods, Volume II, page 449 (1899). The scheme was recommended for all kinds of

objects, and the individual number is prefixed to the regular numbers, instead of added, and the day of the month comes first. Thus, the example quoted, a specimen collected on August 12, 1899, would be 1–12–8–99, 2–12–8–99, and so on.

Mr. Ball replied that the system referred to by Mr. Caudell related to keeping slides of embryological and histological material, and while the date system part of it was the same, the application was quite different. He had been using the system five years before that one was published. He also said that every collector ought to be able to give the genus of the specimens taken, but that if he could not, a few descriptive words would serve to identify the species when the material was worked over. He suggested that it be borne in mind in the discussion that the present system was not offered as an improvement upon the systems of Messrs. Felt, Hopkins, and Forbes, nor for any laboratory where they had help enough to carry out one of these systems, but that he thought that it was an improvement upon the system in use in the majority of economic laboratories and that the date system feature might be incorporated into any system to advantage.

Mr. Ashmead indorsed Mr. Hopkins's system and said that he always put the name of the collector on the specimens received at the museum. He ordinarily used two labels, but three were used when the original label of the collector was retained. He thought it of primary importance to accompany the specimen with the name of the collector.

Mr. Bruner agreed that the name of the collector should always appear and said that he used printed labels.

The session then adjourned to meet at the capitol at 9 o'clock the next morning for the purpose of looking over the State museum, returning to the high-school building at 10 a. m. for the morning session.

MORNING SESSION, AUGUST 24, 1901.

Mr. Howard read a paper entitled:

A PRELIMINARY REPORT ON THE SAN JOSE SCALE IN JAPAN.

By C. L. Marlatt, *Washington, D. C.*

The investigation of the San Jose scale in Japan by the writer has reached the stage when it is possible to give a definite conclusion on the question of original home so far as Japan is concerned. The report is provisional only in the sense that some work remains to be done in the northern provinces, which can hardly alter the conclusions, and that time and facilities are lacking to make it full and complete.

In the three months already spent in Japan the writer has explored the main islands pretty thoroughly from Tokio southward to the

lower extremity of Kiushu—the large island completing the chain on the south. In all some 35 provinces or districts have been visited and carefully examined, the points being selected where orchard and nursery interests were oldest and most important. There remains to be explored the north half of the main island (Hurdo) and the northern island of Hokaido, the whole of Japan covering a stretch of latitude about the equivalent of from Newfoundland to Florida.

The Japanese Government has taken and is taking the greatest interest in the investigation, and has sent out with the writer one of the officials of the Central Agricultural Experiment Station of Tokio, Mr. S. K. Hori, a capable entomologist of Cornell training, and, furthermore, has interested the agricultural experiment stations and schools and governing authorities in the provinces throughout the Empire in the investigation, and extended a multitude of courtesies which it would be impossible here to list.

All scale insects have been studied and collected, and especially those of fruit trees and economic plants, and—as far as possible without interfering with the main object—other injurious insects also.

This report, however, relates to the San Jose scale exclusively, except as it seems desirable to include some facts discovered relating to the peach, plum, cherry, and mulberry scale (*Diaspis pentagona*), the very general occurrence of which in Japan has a very marked influence on the rôle played by the San Jose species.

To give a correct picture of conditions, some knowledge of Japanese fruit-growing must be had. In the first place, this industry as known to America is unknown in Japan, except in a few small districts.

The great mass of the Japanese fruit trees are grown as yard ornaments, or in little garden patches attached to the dwelling houses. Every little thatched cottage has its flowering cherry tree and plum tree, and very possibly a pear, a peach, a persimmon, and very often an orange tree. Sometimes two or three of each sort will be grown, and the more pretentious gardens of the wealthier townsmen amount to miniature orchards—the different fruit trees and ornamental plants being jumbled together in rank confusion. In other words, the popular fruit and flowering trees, while universally grown, are in very small numbers.

There are a few orchard districts where numerous patches of from one-fourth acre to 3 or 4 acres of fruit trees occur. These are chiefly of the old native pear tree, more or less invaded by replantings of American trees or new orchards of the same, some small apple orchards, (more extensive in the north, where I have not been) very rarely a small peach orchard (only two seen), and in the south small orchards (not common) of orange.

The walnut orchards of the island of Kiushu are the only ones that truly compare with orchards in the American sense.

Growing fruit, and especially the deciduous varieties, amounts to little in Japan, but is increasing with the introduction of American

varieties. Her enormous population of 46,000,000 has compelled the growth of cereals and other necessities of life wherever possible, and among these necessities tea and mulberries must be included, but these are grown as hedge plants, or where rice can not be grown very often.

A people too poor to enjoy more than the most meager living, the Japanese have not indulged very much in such luxuries as fruits.

Their love of the beautiful, manifested in a thousand ways, finds its most common exemplification in the presence everywhere of flowering trees (cherries, plums, etc.) where fruit trees might be grown, and the conditions briefly described have been characteristic of the country for two thousand years—her agriculture being scarcely altered from the time of Alexander.

The distinctively native Diaspine scale of Japan is the *Diaspis pentagona* already referred to. It is what we know in America as the white peach scale, and which in Italy is the enemy of the mulberry. In Japan this scale is found on the flowering cherry and plum, grown in every dooryard, in all the parks and temple yards, along roadways and along the little strips of soil dividing one rice patch from another, and is almost worshiped in the season of bloom. These trees, cherished as nowhere else in the world, attain a great age, and when protected by dryness or almost immovable supports, inclosed with fences and marked and labeled with imposing stone monuments, become to the entomologist valuable records of insect work or the absence of it, of one or two hundred years' standing. The peach—a rough-barked scraggy tree in Japan—it infests as a rule but slightly. The mulberry is often badly attacked, as are also other plants, and notably the Kaido a green-barked ornamental tree very commonly grown.

The reason for believing this scale insect to be undoubtedly native or introduced so long ago as to practically amount to this is that it occurs everywhere, not only on the main islands, but on the little islands also; and, furthermore, in every dooryard and on absolutely every cherry and plum tree within the limits of the Japanese Empire. Such universal and invariable occurrence I have never witnessed anywhere else, nor in the case of any other scale insect.

Very rarely does it occur more than scatteringly, so that great damage is not often suffered. Chalcidid parasitism does not play so important a rôle in keeping it thus in check. The chief agent in this direction is a little twice-stabbed ladybird, which I identify from the named collection at the hands of Mr. Nawa, at Gifu, as *Chilocorus similis* Rossi. This little beetle, looking almost exactly like our *C. bivulnerus*, though possibly smaller, is everywhere with the Diaspis, feeding as larva or adult on it, and keeping it from often developing in large numbers.

The San Jose scale, on the other hand, presents a very different picture, and is undoubtedly of comparatively recent origin in Japan.

While occurring rarely on many plants, it is economically limited

to its attacks on the pear and apple, having spread (rarely, as the conditions show) to the others from these two.

The pear in Japan is represented by the old orchards of native trees and dooryard or garden trees, usually also native for the most part. These orchards and trees are usually of considerable age, fifty to one hundred years, except the replants. During the last thirty years a good deal of American pear stock has come into Japan chiefly from California without any fumigation, and very often undoubtedly infested with the San Jose scale.

The nursery business in Japan is very largely limited to three principal nursery districts or communities, and these were early thus infested, and the new stock from America and the native varieties grown in the nursery alongside of the former, and infested therefrom, have been sent out all over the Empire in small lots and used to replace trees in old native orchards or planted here and there in yards and gardens, scattering the San Jose scale exactly as it was in eastern America a few years ago, and the San Jose scale conditions in Japan to-day are the exact counterpart of what they are in our Eastern States.

In many instances I was able to see the beginning of scale infestation on American or other stock obtained but a few months before from one or other of these nurseries, two of which I have examined. In two instances, at least, the San Jose scale was on the young stock of experiment stations—American varieties, which the stations were experimenting with and about to introduce in their respective provinces.

In most of the orchards of native trees only, the scale had acquired but a very slight foothold. Newly set trees (which were traced in nearly every instance to one of these nurseries) were the centers of contagion, or in some instances new orchards alongside of old ones had carried the scale to the bordering trees of the old orchard.

Old native pear trees in yards and gardens are usually still exempt from this scale, and when infested, easily accounted for by the near-by presence of new stock. It very naturally suggested itself that the native pear of Japan is resistant to the San Jose scale, and this is the more plausible because it is a rather scraggy, rough-barked plant, much more so certainly than the American varieties.

A very little examination demonstrated, however, that the San Jose scale once carried to one of these native pear trees affects it just as severely as it does the American variety. In other words, it is not scattering or rare, but when it once gains lodgment, multiplies rapidly in the temporary absence of its ladybird enemy, and occasionally kills a tree. Were it a native species we should certainly find it widely scattered, though probably sparingly, in these old orchards and yardtrees, as is the Diaspis on the cherry and plum, etc.

The apple is scarcely grown at all in the south two-thirds of the Empire, save as exemplified by a few orchards near Tokyo. Further-

more, this fruit as economically cultivated is of recent and purely American origin. The native apple of Japan is a crab, grown more for ornament than fruit, and a very rare tree, unknown to most Japanese.

The improved varieties of apples now grown here came from America (California), and the industry is not 30 years old. Much of the stock was undoubtedly infested when received, and I am informed that the orchards of north Japan have suffered much from this insect from the start, although the nature of the trouble has not been long recognized. Its very general non-occurrence in the one or two-hundred-year-old plum and cherry trees, or those of lesser age grown in thousands throughout the Empire, is very significant, especially as it attacks both of these trees when carried to them. It should be remembered also that Koebele did not find it in Japan at all some ten years since.

It is perfectly patent, therefore, that the San Jose scale came from America to Japan on American fruit trees which have been regularly imported during the past thirty years, and chiefly from California, where the San Jose scale has been longest and worst. Its wide distribution in Japan has been by the leading nurseries, just as in America.

It is here that the Diaspis has benefited Japan. The little ladybird enemy of this native scale insect has taken readily to the introduced species, and has very materially checked its injuries. As already shown, there is not a corner in all Japan where this ladybird does not occur with the Diaspis, and wherever the San Jose scale has been carried it has found this active and fecund predaceous insect ready to devour it, and very rarely does a tree at all badly infested long escape discovery and measurable protection. Isolated trees may become covered with scale before the beetles find them, or new orchards and replanted trees infested with scale will be injured, but it does not last long, as a rule.

The San Jose scale is attacked also by one or two Chalcidid parasites, presumably the ones we have in America and brought to Japan with the scales or cosmopolites. (Sent to Dr. Howard for identification.)

Further, the San Jose scale, together with other Diaspine scales in Japan, is badly attacked very often with what appears to be the same orange-colored fungus which we find in our Southern States. The climate here is especially favorable for the fungus—moist and sultry heat characterizing much of the year.

So much for the origin and present status of the San Jose scale in Japan. It may be of interest to add some notes on one or two allied subjects.

For a long time the Japanese entomologists and some foreign ones, notably in Germany, have held that the scale in Japan represented a different species, or at least variety, from the American insect. I am now able to confirm an older belief of mine that this is not the

case. The Japanese insect is the typical San Jose scale. All the features and characters noted in the so-called varieties may be found in a single colony together with the typical scale as we know it in America.

I merely mention this misconception here to report a false security felt by German importers and officials in letting Japanese plants come into Germany and other European countries without check until within the last twelve months, when Germany included Japan with the United States as dangerous sources of plants.

The dwarf pear and apples, etc., in the chief nursery of Japan are, as I have found, all infested with San Jose scale. (The dwarf trees are ordinary nursery trees from the nursery rows, starved and cut back, and not special varieties.) These have been exported, the proprietors inform me, to America, to two or three ports in Germany (up to twelve months since), and are still sent to England. When sent to America they are now fumigated, because Mr. Craw has sent some lots scale-infested to limbo. Most of the export plants are ornamental plants, pines, maples, etc., but a good many of the quaint dwarf fruit trees in flower pots and bearing fruit are also sold and shipped abroad. I do not think this need alarm Europeans, for I much doubt whether, with the climatic conditions of Europe and with the conditions of fruit growing there, the San Jose scale ever will amount to much on that continent.

In connection with the identification of the San Jose scale in Japan, I wish to add that Professor Sasaki, the entomologist of the Agricultural College of the Imperial University, following Professor Cockerell, has held that the Japanese scale was distinct from the form occurring in America. He also expressed to me the alternative belief—not at all compatible with the first, however—that if the same species it came to Japan from America on imported stock.

In the last view he is undoubtedly correct, and I have no doubt but that he will give up the former view, which he has hitherto urged very strongly.

His chief anxiety, evidently, was to free Japan from the onus of the San Jose scale of America one way or another, and both of his theories attained this end. He is therefore well pleased with this report.

As an economic problem the San Jose scale is not so important for Japan. It is widely distributed already, and extermination is out of the question, but the natural conditions of climate, character of fruit growing, fungous disease, and parasites will probably always keep the scale in check.

Most orchards of pear and apple, etc., are grown as we do grapes, on trellises, and the trees are cut back to mere dwarfs, all the branches being within easy reach.

Labor is so cheap that the trees can be given a very thorough hand scrubbing every winter, and now in places it is the practice to do this

with a salt-water wash, just on general principles of cleanliness. I have felt it merely necessary to recommend soap instead of salt as more valuable where scales are concerned.

The important feature for America is the Japanese ladybird (*Chilocorus similis*). With the literature available here I can not determine whether this beetle has already been carried to America by Koebele or Compere, but I am expecting daily information on this point from Washington, so that if necessary I can send, or at least make the attempt to send, living beetles to California and the East.

A general discussion followed the reading of Mr. Marlatt's paper.

Mr. Cockerell said that he was very glad to hear Mr. Marlatt's paper, as it threw a great deal of interesting light on the conditions existing in Japan. Hitherto we had greatly lacked information of this sort. He wished to correct one statement in the paper, that he (the speaker) considered the Japanese insect distinct from the true San Jose scale. This was the exact reverse of the truth, but he did consider that the scale presented some varieties in Japan, as, for example, the one feeding on orange trees, a thing the insect in California never did. Mr. Marlatt's statement about the Chilocorus was very interesting. The speaker had noticed a similar case in Arizona when the *Chilocorus cacti*, feeding normally on the native *Diaspis toumeyi*, came to prey upon the introduced date palm scale (Parlatoria). As regards the main proposition advanced by Mr. Marlatt, that the San Jose scale was certainly not a native of Japan, Mr. Cockerell could not see that any proof had been offered. The fact that the insect occurred mainly upon imported American varieties was just what might be expected if it were native to Japan, as the American varieties would be less resistant than the Japanese. It has been observed by Dr. John B. Smith that the Keiffer pear was, to a considerable degree, resistant to the scale. Now, this pear was a hybrid with the Chinese sand pear, and it seemed to show that trees having Chinese or Japanese blood, or one should say sap, were more or less resistant to the scale. The fact that the scale was not found on wild plants in Japan proved nothing. Mr. Cockerell had found many Coccids in New Mexico on wild plants, and though the plants were abundant the Coccids were usually confined to very limited localities, and even after years of residence in the immediate vicinity were very likely to be overlooked. He also knew of cases such as those of *Toumeyella mirabilis* and *Dactylopius prosopidis* in which these isolated colonies were entirely destroyed by parasites or predaceous enemies.

The San Jose scale belonged to a Palæarctic or at least a Holarctic group, and must surely have originated in the northern temperate zone. It certainly could not be supposed to come from Europe, and

it did not seem likely that it was American. Hence, on general principles, one would look for its home in eastern Asia. However, the speaker thought it might just as well have come from China as Japan.

In concluding, Mr. Cockerell said he did not accept the view that *Diaspis pentagona* was certainly a native of Japan. On some such grounds as those mentioned by Mr. Marlatt it might be referred to Jamaica and various other places. He did not consider we yet knew certainly where this scale originated.

Mr. Jordan said that a very large proportion of the flora of Japan came from China, more especially the fruits, and it was therefore possible that the San Jose scale might have been introduced into Japan from China. Upon his trip to Japan he was impressed with the utter neglect of the orchards in that country and the wholesale destruction of birds.

Mr. Kellogg said that Mr. S. I. Kuwana, assistant in entomology at Stanford University, spent all of last summer collecting and studying the Japanese scale insects, giving special attention to the San Jose scale. Eighty species were taken, twenty of which were new. Mr. Kuwana visited three of the four principal islands of the Empire, and found the San Jose scale generally distributed throughout these islands in native orchards as well as on imported trees. The San Jose scale has been known to the natives of Japan for more than thirty years under the name of ki-abura. He could not agree with Mr. Marlatt that the weight of evidence was in favor of America as its native home. He was of the opinion that there were not yet sufficient facts at hand to determine this point definitely, but that the present indications were that the insect came from Japan to California. He stated that Mr. Kuwana had found the scale attacked by parasites and predaceous insects, which would have some weight in favor of Japan as its home. He thought that both Mr. Marlatt and Mr. Kuwana had made a mistake by confining their investigations to the lines of the railroad instead of giving the wild plants more particular attention.

Mr. Howard said that in his opinion Mr. Kellogg's statement as to parasites did not affect the point in question, that native parasites might attack an introduced species of scale. He thought also that old native trees were quite as liable to the attacks of scale as introduced plants. He said that Mr. Marlatt's wide experience in the study of the Diaspine group of scales in the eastern United States admirably equipped him for the investigation now in progress in Japan and that his expressed opinion should have the greatest weight. He held to the opinion that the weight of evidence indicates that Japan is not the original home of the San Jose scale, but that it was introduced into Japan from America; but stated that Mr. Marlatt would be instructed to extend his investigations into the wild country, in the hope of securing further facts bearing upon the question at hand.

The next paper on the programme was presented by Mr. Hopkins:

NOTES ON (1) THE PERIODICAL CICADA IN WEST VIRGINIA; (2) THE HESSIAN FLY; (3) THE GRAPE CURCULIO.

By A. D. Hopkins, *Morgantown, W. Va.*

[Withdrawn for publication elsewhere.]

Mr. Ehrhorn wanted to know if the parasite of the Hessian fly was abundant in West Virginia, and stated that these parasites did not exist in California, and that he desired to obtain some material in the hope of establishing it in his section.

Mr. Hopkins replied that these parasites were very abundant last year, but not effective.

Then Mr. Felt presented the following paper:

FURTHER NOTES ON CRUDE PETROLEUM AND OTHER INSECTICIDES.

By E. P. Felt, *Albany, N. Y.*

A preliminary paper on some work along these lines was read by the writer at our last meeting and a full account of the experiments in 1900 has been presented in his report for that year, and the results there set forth need no repetition at this time. No very apparent differences among the trees experimented upon, aside from those recorded during 1900, were observable in the spring of 1901. All the trees passed the winter about equally well, after making due allowance for their condition, and though several trees died, it was only those which were in a desperate condition the preceding autumn. It is rather significant that of the three trees sprayed with undiluted kerosene in the spring of 1900, but one was alive a year later, and of the four treated with undiluted petroleum, but two were alive, and both of these came through the winter with a large proportion (25 to 50 per cent) of their branches dead. It is but just to add that most of these trees, as previously recorded, were at the outset very badly infested with San Jose scale.

The poor results obtained with spring applications of kerosene and mechanical emulsions of the same led to the concentration of the work on the more promising insecticides, namely, crude petroleum and whale-oil soap in various combinations.

Another test was made with undiluted crude petroleum. Some oil was sent me direct from the Frank Oil Company, Titusville, Pa. It was a light amber-colored oil, said to test from 44° to 45° on the Beaumé oil scale, and in the field, just before spraying and at a temperature of about 65° F., it gave a reading of 43.3° Beaumé. Two trees were sprayed April 11, 1901, with this oil. The day was bright

and there was a gentle breeze. Tree 116, a badly infested Lombard plum, showed serious injury July 3, at which time several limbs were dying and the remainder did not present a normal, vigorous appearance. August 9 the tree was dead and all the leaves thrown out in the spring had shriveled. Tree 117, a very badly infested Crawford peach, was also sprayed at the same time, and July 3 it was dead.

It might be added that the oil was used liberally, and that in the case of tree 117 the infestation was so very bad that it was hardly expected that the tree would survive.

Some comparative experiments with mechanical crude petroleum emulsions were made. The above-described oil from Titusville and an oil used in the experiments last year were tried. The latter was purchased in the Albany market as crude petroleum sold by the Standard Oil Company. It is a quite fluid greenish oil, and that used in 1901 gave a reading in the field of 41.8° Beaumé. Neither the 20 nor 25 per cent emulsions of either oil injured the trees, so far as could be seen, this agreeing with the results obtained with the emulsions of Standard oil in 1900. The Standard oil, that is the heavier one, appeared to be a little more effective as an insecticide, but as the lighter Titusville oil has been used in 25 to 50 per cent emulsions without injuring the trees and with very satisfactory results as an insecticide, it would appear that the heavier the oil the less can be used with safety and the more effective it is as an insecticide. There is evidently a very narrow margin between the amount of this substance necessary for satisfactory work against scale insects and that which will seriously injure or kill trees, especially peach and plum trees, and in the case of those very badly infested, particularly if the bark is quite rough, it is doubtful if enough oil can be applied to kill practically all the insects and at the same time not injure the tree seriously.

The experiments tried last year with a combination of 1 pound of whale-oil soap to 4 gallons of water, to which was added 10 per cent crude petroleum, were not quite satisfactory, as it was hoped that the combination would prove more effective as an insecticide and less injurious to the trees than either substance separately in the usual proportions. This year both 10 and 15 per cent of the crude petroleum obtained from the Standard Oil Company were used in combination with the pound to 4 gallons solution of whale-oil soap. There was no perceptible injury to the trees in either case, and the San Jose scale was pretty thoroughly checked with both mixtures, the one with the higher per cent of oil giving on the whole the best satisfaction.

The results obtained with whale-oil soap solutions, both $1\frac{1}{2}$ and 2 pounds to the gallon, were up to date practically the same as those of last year. The scale was severely checked, but in no instance was it so thorough as where crude petroleum in some form was used. Two pounds to the gallon gave a little better result than the weaker solution.

Mr. Scott said that he had made similar experiments in Georgia looking to the control of the San Jose scale and had obtained gratifying results. He had used a 25 per cent strength of crude oil with water on peach and plum trees, spraying in the winter time, with the results that the scale had been effectually destroyed and the trees not damaged. He had found, however, that the undiluted crude oil killed peach trees outright, as did also refined kerosene. He had used the Pennsylvania crude oil registering 43° on the Baumé oil scale. The high price of the crude oil, as purchased from the Standard Oil Company, made it more expensive than refined kerosene, and for that reason, and because of its variable character, he did not recommend it for general use. For three years he had used a 20 per cent strength of kerosene with water as a remedy for San Jose scale, and the results were all that could be expected from the application of any spray whatever. He said that at the recent meeting of the Georgia State Horticultural Society the general expression from the fruit growers was to the effect that the San Jose scale was no longer feared since the kerosene treatment had proved so effective. He said that infested orchards of more than 100,000 trees each were being successfully treated.

Mr. Felt suggested that perhaps the San Jose scale did not become so dormant in Georgia as it did farther north, which would explain the successful use of comparatively weak applications of insecticides.

Mr. Scott replied that this was true, as he had frequently found the scale breeding on warm days in midwinter.

Mr. Kellogg expressed a surprise that the price of crude petroleum should be so high, and suggested that it might be obtained at a reasonable price direct from the oil wells.

Mr. Gillette then presented the following paper:

NOTES ON SOME COLORADO INSECTS.

By C. P. Gillette, *Fort Collins, Colo.*

Nysius minutus has been unusually abundant in portions of Colorado this summer, and numerous inquiries have been received concerning it.

My attention was first called to it by being told that it was destroying the strawberries upon the experiment station grounds. A visit to the strawberry patch was made at once and the bugs found in large numbers upon leaves, fruit, and blossoms, but most numerous upon fruit, both green and ripe. They were not giving special attention to strawberries, however, as they were much more abundant on some of the weeds growing between the rows, and particularly were they abundant upon wild mustard and *Monolepis nuttallii*, wilting the plants to the ground. Plants of yellow dock, and even Helianthus, were literally covered with them. In fact, hardly any species of plant in the

vicinity entirely escaped the accumulations of these bugs; but that all served as food plants I am not certain. It is a common insect in the State upon beets, and has been reported to me as injuring cabbage and cauliflower.

The usual contact poisons—kerosene emulsion, whale-oil soap, and buhach—were used upon the bugs in the ordinary strengths without satisfactory results. In fact the most thorough applications would hardly kill any of these insects.

Aspidiotus howardi was first found by the writer some years ago at Canon City, Colo., where it was present in injurious numbers upon European and American varieties of plum, attacking both twigs and fruit. Scattering specimens were also noticed at that time upon pears. While the scale has remained in considerable numbers in the small plum orchard where it was first found, I have not known of its occurrence in any other locality until the present summer, when I was called by the horticultural inspector of Delta County, Mr. H. E. Mathews, to go with him to determine what scale was infesting a pear orchard in the vicinity of Delta. The scales could be found upon nearly all the pear trees in the orchard, attacking both bark and fruit, chiefly the latter. There were but few trees upon which the scale could be said to be abundant. We visited the orchard June 12, at which time young lice were hatching in small numbers. These were of the usual yellow color, but the little scale that first forms over them is pure white. From that date to August 20, at least, these young lice have continued to appear. On raising the scales from the females I nearly always found two or three young lice beneath them, and for some time thought the scale must be viviparous, but a new lot of the scales sent by Mr. Mathews August 17 contained females beneath which eggs were found. The eggs apparently hatch very soon after they are deposited, as it is usual to find two or three young lice and but one or two eggs under a female. Possibly the females are both oviparous and viviparous.

The scales cluster, for the most part, about the blossom end of the pears, and where they rest upon the cheek of the fruit they usually cause a depression and sometimes a red ring, which is considered to be characteristic of *perniciosus*. In this orchard occasional scales were found upon plums also. I have fruit with me with these scales upon it that you are at liberty to examine.

Chermes abietis.—This louse is abundant upon silver spruce in Colorado, especially in high altitudes, causing the cone-like galls at the tips of the new growth. The galls are always present in considerable numbers in trees of silver spruce upon the college campus at Fort Collins.

Chermes sp.—Two species (possibly one) of Chermes, one infesting Douglass spruce and one pine (*Pinus ponderosa*), are abundant nearly every year in the northern portion of the State, at least about Fort

Collins and Denver. Like *C. abietis*, these also deposit their eggs in clusters, each egg being anchored by means of one or more waxy threads, and covered with a white waxy secretion from the abdomen of the female. These lice are very small, not exceeding a millimeter in length. They are dark in color and are all wingless early in the season. Early in June winged individuals appear. These winged females have less of the waxy secretion with which to cover the clusters of eggs that they lay upon the leaves, and so they cover them with their enormously large wings. Both species seem to be entirely oviparous. The newly hatched lice arrange themselves in rows along the leaves, and when the white secretion is well formed they are completely covered by it. The species infesting the pine is specially numerous at the new growth at the tips of the twigs, and the little lice winter very largely between the pairs of needles that grow together and near their base.

Both lice and eggs are readily killed by the use of kerosene emulsion or whale-oil soap. (Photographs were shown illustrating these lice.)

PLANT-LICE.

The grain louse (*Nectarophora granaria*) did considerable damage in eastern Colorado last year. I know no previous record of its occurrence in this State. This year it has occasioned no complaint, and I have no knowledge of its occurrence.

Last year Mr. Ball investigated the injuries of this louse along the line of the Santa Fe Railroad in the State and found wheat, oats, and barley attacked, but the chief injury was to wheat.

The snowball plant-louse (*Aphis vibernum*) is a comparative recent acquisition in the northern portion of the State. For the past two years it has been rather abundant upon snowball bushes upon the campus of the State Agricultural College at Fort Collins.

The ash gall louse (*Pemphigus fraxinifolia*) continues to be one of the worst pests that our ash shade trees have to contend with on the plains of the eastern slope in the State. It is not destructive to the trees, but seriously mars their beauty, and the secretions that fall from the lice are annoying, to say the least, to those who would enjoy the shade of one of our best lawn trees.

The apple louse (*Aphis mali*) has become one of the most common of our plant lice within the State, occurring upon both slopes. The eggs blacken the twigs of apple trees in the fall so that they are noticed during winter by the owners of orchards, who send them to the Entomologist for identification. The strange thing about these eggs is that we have not been able to find any lice hatching from them upon trees where they are deposited, and twigs have been brought into the laboratory bearing thousands of eggs of this louse; but we have not succeeded in getting any to hatch. It does not seem that it could

be due to lack of fertilization, as the little wingless brown males occur in large numbers and freely copulate with the females during the fall.

The cabbage louse (*Aphis brassicæ*) seems to be a worse pest upon cabbages and cauliflowers than the cabbage butterflies, *P. rapæ* and *P. protodice.*

The beet army worm (*Laphygma flavimaculata*), which ravaged the sugar-beet fields to such an alarming extent in the Grand Valley in the summer and fall of 1899, was almost entirely absent over the same area in 1900, in spite of the fact that the moths emerged in enormous numbers late in September for hibernation. They did occur in considerable numbers last year, however, in the vicinity of Rockyford, Colo., where sugar beets were being grown for the first time in large numbers for commercial purposes. The past summer the first brood of this insect appeared in considerable numbers, both at Palisade, in the Grand Valley, and in the Arkansas Valley in the vicinity of Lamar. It is now time for the second brood to be on in full force, but I have heard nothing of it yet. It looks as though another native insect, formerly unknown as a destructive species, had come to stay as an enemy to beet culture.

The cabbage Plutella (*P. cruciferarum*).—A curious instance in the food habits of this insect was called to my attention the present summer. Mr. H. E. Mathews, horticultural inspector for Delta County, sent me a quantity of leaves from small peach trees, with hundreds of small white cocoons upon them, with the statement that some new peach defoliator had appeared in an orchard in Delta County and he wished me to tell him what to do about it. I could not tell what the insect would turn out to be, but in a few days moths of the cabbage Plutella appeared in large numbers, and I was almost as much puzzled as before. I told Mr. Mathews the ordinary food habits of the insect, and then he explained that the year previous the ground in this orchard had been allowed to grow up to a wild mustard, and that the weeds had been thoroughly kept down this summer. The moths, doubtless, hatched there in large numbers and, not finding their natural food plants, deposited eggs upon peach leaves, upon which the larvæ developed. (Photographs of the cocoons of this insect upon peach leaves were exhibited.)

The thistle butterfly (*Pyrameis cardui*) was unusually abundant throughout the State while fruit trees were in bloom, so that many inquiries were made as to the significance of this insect in such numbers.

The bean ladybird (*Epilachna corrupta*) does considerable damage to the foliage of beans, particularly wax beans, near the foothills of the east slope of the mountains every year, but the degree of destructiveness varies much. The present season the injuries have been more severe than for several years past. It is also difficult to combat on account of the beans being very susceptible to injury from the

application of arsenical mixtures and the further fact that nearly all feeding is done upon the under side of the leaves. The arsenicals, however, seem to be our best means of destroying the beetles by means of insecticides.

Phytoptus sp.—There is a Phytoptus mite that seems to be steadily on the increase in Colorado, which attacks the cottonwoods. As the leaves open in the spring, reddish excrescences begin to form about the buds and upon twigs and limbs, of a more or less reddish color, that continue to enlarge in size during the summer. The year following, additional growth may appear about the old gall and new ones form. In early spring the mites within the chambers of the galls are of a deep red color, while those that appear during the summer are lighter in color. In the northern portion of the State these galls are so abundant as to be very noticeable to passers-by when the foliage is off. Some trees are literally filled with them, so that scarcely a twig can be found without one or more of the galls upon it.

Another peculiar development, as the result of Phytoptus attack in the cottonwoods, takes place in the same trees, and may be due to the same species, so far as I know. It is the transformation of the flower catkins into large pendant masses, often 6 or 8 inches in length, reminding one of a long slender cluster of grapes. An interesting thing in connection with this abnormal growth is that the attack of the mites causes the flower parts to revert into leafy growths, pointing to the origin of the development of the parts of the flower.

LEAF-CUTTER BEES.

Until the present summer I have never heard of leaf-cutter bees being abundant enough to seriously defoliate plants, but am told by an intelligent lady residing near Fort Collins, some 10 miles from the foothills, that her rosebushes were so badly defoliated by them the past summer that it was necessary to cover them during the day to save any leaves at all.

Mr. Caudell said that in the garden of W. M. Rysler, of Delta, Colo., this season he saw a number of mature radishes, every plant of which was completely killed by the minute false chinch bug (*Nysius minutus* Uhler), myriads of which at that time covered the entire plants. In some gardens he saw a patch of potatoes much injured by the larvæ of *Plusia brassicæ*. The injury was so striking as to be noticeable from a distance, resembling the ravages of the potato beetle. These same larvæ were infesting cabbage, cauliflower, lettuce, sugar beets, and garden beets.

Mr. Hopkins said that he had collected the galls of a *Chermes* sp. (which Mr. Pergande thinks may be *Chermes sibiricus*) from the Sitka

spruce at Newport, Oreg., and from the Engelmann spruce at Sand Point, Idaho.

President Gillette then announced that the proposal of new members was again in order, whereupon the following names were offered and received:

W. D. Hunter, Washington, D. C., proposed by Mr. Bruner; Vernon L. Kellogg, Stanford University, Cal., proposed by Mr. Bruner; Dr. W. J. Holland, Pittsburg, Pa., proposed by Mr. Hopkins.

The meeting then adjourned for lunch, to reassemble at 2.30 p. m.

AFTERNOON SESSION, AUGUST 24, 1901.

Mr. Scott presented the first paper of the afternoon programme, viz:

A PRELIMINARY NOTE ON A NEW SPECIES OF APHIS INJURIOUS TO PLUMS AND PEACHES IN GEORGIA.

By W. M. Scott, *Atlanta, Ga.*

Early in April, 1898, I observed a chestnut-brown Aphid in great numbers attacking plum trees in an orchard at Fort Valley, Ga. The insects were crowded thick on the growing tips and leaves of several thousand plum trees, and their injurious effects were then evidenced by the curled and twisted condition of the leaves and stunted appearance of the young shoots.

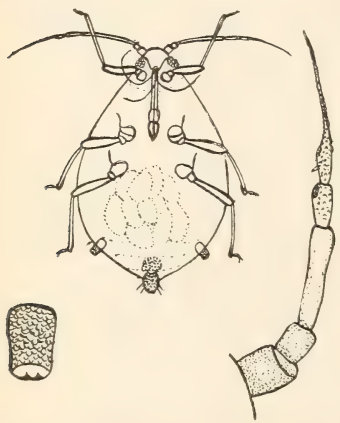


FIG. 1.—*Aphis* n. sp: stem mother on peach and plum in Georgia, much enlarged (from drawing furnished by Scott).

Thinking it was probably only one of the well-known species of plant-lice common to the plum, I took no special notice of it more than to have the infested trees treated with 10 per cent kerosene in mechanical mixture with water, which proved to be an efficient remedy.

Several days later the same conditions were found in plum orchards at Marshallville, and during the course of the season the insect was located at a number of places in middle and south Georgia. The following year, 1899, this insect again showed up in numbers even more injurious than when first observed. Investigations during that year showed it to be generally distributed over the State, equally prevalent in the northern, middle, and southern portions. It was then found to infest the peach as well as the plum. Its natural food plant would appear to be the wild plums, as these were found badly infested in every section of the State. Among the cultivated plums the Wild Goose, Robinson, and Mariana appear to be favorites of this insect, but the Japanese varieties also suffer serious damage from its attacks.

In July of the same year specimens of this Aphid began to be sent to the office as being injurious to the nursery stock, and the fall nursery inspection showed it to be a serious pest in the nurseries, particularly on June-budded peach trees. The terminals are attacked early in the season and further growth is seriously checked.

It soon became evident that this plant-louse was not one of the species commonly known to infest stone-fruit trees, as I had first supposed.

Accordingly, on November 4, 1899, specimens of this insect were submitted through Dr. Howard to Mr. Pergande, who identified it as apparently a new species of the genus Aphis. (This information was accompanied by the statement, "I think it well worth your while to make a careful study of this insect.")

San Jose scale overshadowed every other pest, and all of my time was occupied in dealing with it. At that time, therefore, it was out of the question to start any breeding work whatever, and nothing

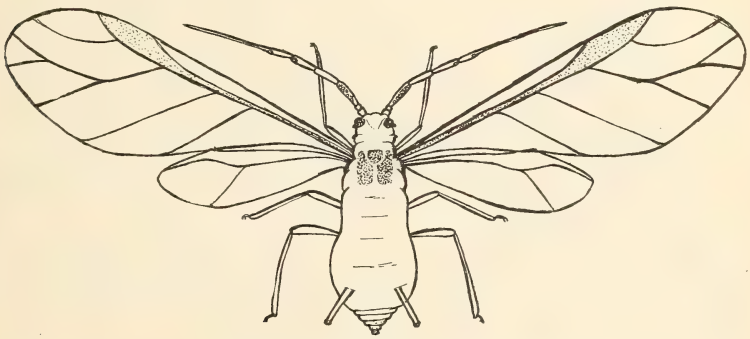


FIG. 2.—*Aphis* n. sp: winged form on peach and plum in Georgia, much enlarged (from drawing furnished by Scott).

could be done on the Aphis more than to make general field notes. At the last session of the State legislature, however, I was given an additional appropriation, which made possible the employment of an assistant and an extension of the work.

While the nursery and orchard police work still demands most of the time of both my assistant, Mr. W. F. Fiske, and myself, it was decided that between us we might trace out the life history of this new Aphid. Accordingly, on March 25, 1901, a plum tree in Atlanta, which I had noted the previous year as being badly infested with the lice, was examined just in time to find the newly issued to nearly full-grown larvæ present. These had apparently hatched from over-wintering eggs, as evidenced by the presence near them of the dark-brown shells, and the five antennal joints that developed in the adult as against six joints in the adults of succeeding generations.

From these stem mothers, colonies were established both in the laboratories and in the open air on young plum trees grown from

Mariana cuttings and also on peach seedlings. Isolated colonies on the original plum tree were also watched.

In some colonies when members of the fifth generation reached maturity, on May 8, winged individuals developed, while in other colonies the winged form did not appear until the sixth and seventh generations were reached. Our field notes show that the winged form appeared in south Georgia as early as April 18, and, indeed, winged individuals were found in great numbers in Atlanta on a plum tree that was not at first under observation as early as May 1.

All forms that have been observed to the present date are parthenogenetic. Only a small percentage of a colony would become winged, but winged individuals have continued to develop in every generation until the present date (August 14).

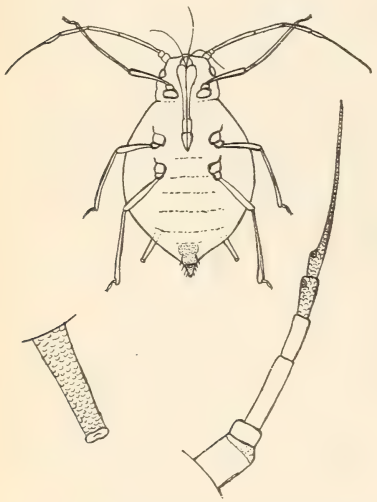


FIG. 3.—*Aphis* n. sp: adult from winged form, much enlarged (from drawing furnished by Scott).

After about twenty-four hours from maturity the winged individuals leave the colony and establish themselves, either singly or in groups of two or three, upon neighboring trees, where they feed for several hours before giving birth to young. The terminals of succulent shoots were invariably selected, and the peach seemed to be preferred to the plum; in fact, the winged were never observed to locate on the plum, although several plum trees were growing on the grounds.

It was never observed that the direct offspring of the winged form developed wings, but some individuals of the second and succeeding generations usually do so.

It was also observed that when a colony was kept reduced to a small number of individuals no winged individuals would develop, but when allowed to increase to considerable numbers some such would always appear.

On August 14 some of the colonies had been carried to the tenth generation from the winged.

In order to get further assurance that an old species was not under observation, specimens were taken from one of the breeding numbers and submitted to Mr. Pergande, who again identified the insect as a new species of the genus Aphis.

It is desired to carry this breeding work on until the true males and females are secured before describing the species.

Adalia bipunctata frequented our breeding colonies in great num-

bers, and it was a continual fight between us and the beetles as to which should have the lice.

The larvæ of Scymnus, as well as certain Syrphid flies and Chrysopidæ, also preyed upon this Aphis.

In the discussions of this paper Mr. Ashmead said that the record of this new Aphis attacking the stone fruits was very interesting, inasmuch as this group of plants already suffered from the attacks of half a dozen well-known species of plant-lice. He suggested that the Aphididæ afforded a splendid field for investigation, and that there was pressing need for such work. He said that Mr. Pergande was authority on this group and had in his possession the types of both Riley and Buckton.

Mr. Bruner said that his former assistant, the late Mr. Williams, did extensive work upon the aphides, describing 35 species, but that his work had not yet been published.

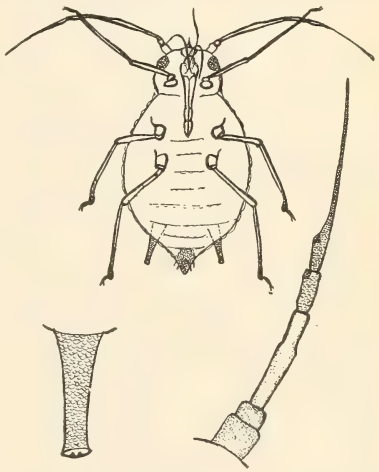


FIG. 4.—*Aphis* n. sp: wingless form fourth generation, fourth stage, much enlarged (from drawing furnished by Scott).

Mr. Gillette called attention to the great danger of the black peach Aphis being disseminated on nursery stock, and said that it had been thus communicated to Colorado from Missouri.

Next in order was a talk upon "Fighting insects with fungous diseases," by L. Bruner, Lincoln, Nebr.

Mr. Bruner said in part that the successful control of the chinch bug in some sections by means of a fungous disease had been a great calamity to working entomologists, because this success had created a false belief that injurious insects in general could be controlled by fungous diseases. As examples of insects destroyed by fungi he mentioned the chinch bug, locusts, and house flies. He said that the disease among grasshoppers would act only when conditions were favorable; that a grasshopper might eat a diseased one and be immune if conditions were not just right.

He had received from the Department of Agriculture what was supposed to be the South American locust disease, which proved to be only a Mucor. The material was distributed over Nebraska, and while some who received it reported good results, others "cussed." In his experiments he had found that none of the locust diseases were successful.

In the discussion of this subject Mr. Gillette said that he often recommended the farmers of his State to grind the diseased and dead grasshoppers as finely as possible in plenty of water and then sprinkle the water upon plants where the grasshoppers were feeding. In his opinion the disease germs are usually present, and the disease will make its appearance when the climatic conditions are favorable. He believes the only object in scattering the germs is to make more certain the spread of the disease when other conditions are favorable.

Mr. Cockerell was of the opinion that the diseases of insects would not be effective in the destruction of scattered individuals, but that where insects were crowded together the introduction of disease would meet with success. He thought much good would result from the dissemination of the diseases of insects.

Mr. Hopkins then read the following paper:

INSECTS DETRIMENTAL AND DESTRUCTIVE TO FOREST PRODUCTS USED FOR CONSTRUCTING MATERIAL.

By A. D. Hopkins, *Morgantown, W. Va.*

There is constantly increasing complaint among the manufacturers and consumers of construction timbers relating to the difficulty of securing material that is free from defects caused by wood-boring insects. This trouble appears to be due to two conditions—one a diminished supply of the best timber, the other that of increased injury to forest trees by insects.

The increase of insects is largely due, it is believed, to prevailing crude and wasteful methods of lumbering and general forest management. The old, defective, and undesirable trees are allowed to stand, which, with the stumps, refuse logs, and tops in the cuttings, serve as breeding places for vast numbers of the kinds of insects which are to blame for the injuries complained of, as well as for increased damage to the standing timber in the remaining uncut forests.

THE PRINCIPAL INSECTS.

The principal insects which are injurious to the wood of forest trees and their timber products may be briefly referred to as follows:

The oak timber worm (*Eupsalis minuta*) is without doubt the worst enemy of oak wood throughout the eastern, middle, and southern United States. It breeds in old stumps and logs, dead and defective standing trees, as well as in living trees, which it is ever ready to enter through the slightest wound in the outer wood, and in a few years the larvæ of successive broods penetrate the heart wood and extend their mines for a long distance above and below the original entrance. Under favorable conditions the larvæ will continue to work in the heavy lumber and square timbers cut from trees thus infested for many years after it is taken from the woods and placed in the structure. Especially is this true with reference to oak timber

used in railroad construction, such as ties and culvert, bridge, and trestling timbers. This insect will breed in old oak logs as long as there is sufficient amount of sound wood for it to work in, and under favorable conditions it will doubtless do the same in railroad ties and other similar material which comes in connection with the ground.

The chestnut timber worm (*Lymexylon sericeum*) is another exceedingly destructive insect to the wood of living, dying, and dead oak trees, stumps, logs, and heavy construction timbers as long as the conditions are suitable for it to do so. The destruction of the wood of old chestnut trees throughout the Appalachian region, so far as its value for construction material is concerned, is well-nigh complete. Otherwise this durable and valuable timber would be a good substitute for the rapidly diminishing oak, and on account of its rapid growth from a young sprout to a tree of commercial size would be a most profitable forest tree to grow for future supplies.

The giant root borer (*Prionus laticollis*) is another enemy of wood which not only breeds in the roots and stems of living oak and other timber trees, but in old stumps and logs, railroad and other timbers which, owing to their connection with the ground, retain a sufficient amount of moisture. Some years ago I observed a large number of larvæ, apparently of this species, in some old oak railroad ties which were being removed from the roadbed in front of the Baltimore and Ohio station in Morgantown. It is therefore evident that this class of large wood borers contribute not a little to the rapid deterioration of oak ties and other timbers.

There is another class of Cerambycid, or round-headed borers, of the Centrodera, Leptura, and other allied genera, which breed in the wood of dead trees and logs, hence are capable of breeding in railroad ties and similar construction material. There are also many species in the family Buprestidæ with similar habit. In the Scolytidæ there are large numbers of species which bore in the wood of living, dying, and dead trees and cause serious defects. Indeed, there is a long list of species of Coleoptera which bore in the wood of trees and construction timbers and contribute to rapid deterioration and decay.

In Lepidoptera there are some very destructive enemies of the wood of living trees, notably the carpenter worms, which infest the oak and locust and bore large holes through the best part of the wood.

In Hymenoptera there are certain wood-boring bees and ants which do great harm to the timber and other woodwork of buildings, bridges, and railroads.

In Neuroptera the termites are among the most destructive enemies of wood and of wooden structures, working both in the moist and sound wood. Recently the writer has determined that these so-called white ants are very injurious to railroad ties and other railroad timbers.

Thus a great variety of insects are to blame for defective timber. They attack the dead, living, and felled trees, the rough manufactured product in the mill yards before it is used, after it is used in the

structure, and until it is so badly damaged that it must be replaced by new material.

When we take into consideration the enormous amount of timber used in railroad construction alone, and the damage to such material by insects, from the time it is taken from the forest until it is replaced by new material in the structure, it is plain that we have in this an economic problem worthy of special attention. It involves not only the determination of methods of preventing losses to vast commercial interests, but the conservation of our forest resources, and the economy of present and future supplies of that which is in greatest demand.

When there was an abundant supply of timber it was possible to select only the best and to discard the defective, but at present it has become necessary, on account of the growing scarcity, to use much timber that is defective. This is evident from the character of the railroad ties and other construction material observed in the lumber yards, and piled along the road ready for use. Therefore, the problem of treating defective timber to promote its durability is becoming an important one. The need of investigations to determine the true character of the various kinds of defects caused by insects and their relations to the entrance of wood-decaying fungi, as a preliminary to the discovery and adoption of practical methods of checking or preventing premature decay, is apparent.

In the accumulation of data relating to the kinds of insects to blame for the commoner injuries, and to some important features in their habits, life history, and distribution, considerable progress has been made within recent years. While this technical knowledge of the insects, the characteristics of their habits, and the character of their work is of prime importance in suggesting methods of preventing losses, there is a feature relating to experiments with such methods to determine and demonstrate their practical application, which requires a considerably greater expenditure of money and time than has yet been available. Indeed, the funds available from public appropriations for original investigations of this character are not sufficient to warrant the undertaking of the elaborate experiments necessary. If, however, private individuals, or companies whose immediate interests are involved, would cooperate with departments of scientific research in this work, as is being done in some other lines of investigation relating to forestry problems, it is believed that results of the greatest value could be attained.

Mr. Cockerell asked whether a moderate number of forest pests might not in a way be beneficial by killing out the old trees and leaving room for the young ones to grow. He also mentioned the curious habits of the sugar cane Xyleborus in the West Indies, which, from attacking dead wood, had come to attack the living sugar cane.

Mr. Scott suggested that Georgia afforded a splendid field for investigations of this nature, as valuable timber in that State was being rapidly destroyed by the work of insects. He made particular reference to the wholesale destruction of chestnut and oak.

Mr. Bruner said that he had been connected with growing trees upon forest reserves and that he had seen the destructive work of these forest insects. He said that species of Dendroctonus kill thousands of trees in the forests of the Black Hills. He thought the Bureau of Forestry should take up the matter of insects in connection with other work, and he thought the time ripe for the publication of a manual on forest insects.

Mr. Hopkins said that the species of Dendroctonus referred to was evidently the one he had determined as a new species, from specimens sent to the United States Department of Agriculture from the Black Hills, to which he had given the manuscript name *Dendroctonus ponderosa*. He also said that it belonged to the division of the genus which includes the most destructive enemies of the pine and was, therefore, doubtless the one to blame for the serious troubles which from time to time during the past three years has been reported from the Black Hills region.

Mr. Felt followed with his paper entitled:

OBSERVATIONS ON FOREST AND SHADE TREE INSECTS IN NEW YORK STATE.

By E. P. Felt, *Albany, N. Y.*

The season of 1901 has not been specially notable on account of insects depredating on either forest or shade trees. The senatorial oak worm (*Anisota senatoria* Sm. & Abb.) is more or less abundant every year at Karner, only 7 miles from Albany. This summer there was a very large deposition of eggs, and by July 27 it was easy to find entire shoots defoliated, and none of the larvæ were more than one-third grown. The scrub oaks (*Quercus prinoides* and *Q. ilicifolia*) are likely to suffer severely before the end of the summer, as is not infrequently the case. The web nests of *Cacœia argyrospila* Walk. were not uncommon on the same oaks, the moths emerging at intervals during the greater part of July and in early August.

Systematic collecting at intervals of ten to fifteen days throughout the season has been practiced at Karner, where there is an admirable growth of scrub oaks and small hard pines (*Pinus rigida*). A portion of the results are given at this time.

The two large Buprestids, *Chalcophora virginiensis* Drury and *C. liberta* Germ., were taken throughout June and in early July, and two of the former species were captured August 9, though not met with on two previous trips. Large numbers of smaller Buprestids were also taken on pine, but they are not included in this account, as they

have not been determined. *Anomala lucicola* Fabr. was present in considerable numbers, mostly on pine, though not uncommon on oak, from June 26 to July 19, and a few were taken as late as the 27th. One or more species of Dichelonycha occurred rather abundantly during the latter half of June and the first week of July. *Monohammus scutellatus* Say and *M. titillator* Fabr. were taken in very small numbers, though larvæ which must belong to these species and to *M. confusor* Kirby appeared to be common enough in this locality. *Glyptoscelis hirtus* Oliv. was captured on hard pine in rather small numbers from June 4 to 26. The common pine weevil (*Pissodes strobi* Peck.) was obtained in large numbers on hard pine, it being specially abundant in June, but occurring in small numbers throughout July and in early August. Two other weevils (*Magdalis lecontei* Horn and *M. alutacea* Lec.) were also taken throughout June and during the first week in July in association with the white pine weevil. The former of these two was even more abundant than the Pissodes.

Bark-borers.—The hard pines at Manor, Long Island, the white pines in the vicinity of Albany, and the balsam or fir trees of the Adirondacks have all suffered more or less from the attacks of various species of bark-borers. Investigations in all of these localities failed to reveal adequate cause for the great mortality among these trees unless it be due to the work of species of Tomicus. I am well aware that Dr. Hopkins, who has made a special study of bark-borers and is a well recognized authority on the group, inclines to lay blame on forms belonging in some other genus. The work of *Dendroctonus terebrans* Oliv. was very common at the bases of the hard pines on Long Island, and I found it in smaller numbers in white pines about Albany, but never in large enough numbers to cause very serious injury. In both of these localities, however, *Tomicus calligraphus* Germ. and *T. cacographus* Lec. and, in some instances, other species were uniformly present and many of the trees bore many pitch tubes, the work in most instances of the first-named form. *Tomicus calligraphus* was found by me last fall working in enormous numbers in dying white pines, the beetles not hesitating to run galleries into living, apparently healthy tissues, and so abundant was the insect that I could not help thinking it responsible in part, at least, for the death of the tree. This month I have found undoubted evidence of *Tomicus calligraphus*' entering what to every appearance were healthy trees. It is true there were not quite so many branches at the top of the tree closely inspected as there frequently is, but the needles were all green and gave no evidence of injury, and the bark from the base of the trees to the top was nice and green so far as the eye could discern, and yet such a one had been entered in large numbers by *Tomicus calligraphus*, and the beetles are even now running primary galleries and depositing eggs. The trunk of this tree was well spotted with pitch tubes, and small masses of pitch had dropped on the leaves

of the surrounding shrubs. The tree above described is only one of a number which show an attack of this character in one stage or another. The condition about Albany is rather serious because many of the nicest trees in the rather small groves of white pine are dying from the effects of the work of this insect and of its allies. At Manor, Long Island, the hard pines covering an area of approximately 60 square miles were largely killed through the agency of bark-borers, and I am inclined to believe that species of Tomicus have considerable to do with the matter. *Tomicus cacographus* Lec. and *T. pini* Say were frequently associated with their larger relatives and in some instances may be the first to attack a tree. This opinion is further strengthened by the fact that *Tomicus balsameus* Lec. undoubtedly kills many balsam trees in the Adirondacks. I have found this species working in immense numbers in the entire length of the trunk of large balsams. The top of one tree examined had browned some, but the lower limbs were apparently unaffected at the time it was cut and inspected. Adults of this beetle were found throughout the tree running transverse galleries in green tissues, eggs had been deposited in many instances and larvæ of various sizes and even pupæ were found. A very interesting case of complete girdling was discovered. Two beetles, starting from the point of entrance on a green limb about an inch in diameter, worked in opposite directions around the limb, and when the specimen was cut, their burrows had overlapped each other by half an inch.

Monohammus displays in New York State a great readiness to attack diseased or dying trees, and I have noted a number of cases where grubs belonging to this genus and also Buprestid larvæ were working in pines which appeared to have suffered no greater injury from other causes than a slight lowering of vitality incident to drought or other unfavorable conditions. These larvæ, though working in considerable numbers in living tissues, did not as a rule cause much exudation of sap. Dr. Packard records in Bulletin 7 of the United States Entomological Commission, page 220, his belief that members of this genus may kill balsam or fir trees, and from what I have seen in the vicinity of Albany, it would appear that this may also be true of pines. Adults of *Monohammus confusor* Kirby were taken in considerable numbers on one white pine, and it is presumable that most of the larvæ found in infested trees belong to this species. One example of *Monohammus titillator* Fabr., one of *M. scutellatus* Say, and one of *Xylotrechus sagittatus* Germ. were also taken on the same tree.

Elm leaf-beetle (*Galerucella luteola* Müll).—This imported species continues to be a serious enemy of European elms in Albany, Troy, and vicinity. The depredations of this pest have been so severe as to lead to the maintenance and operation of two power-spraying outfits by the municipality of Albany. Two are also in operation by a private party in Troy, where they are kept busy throughout the spraying sea-

son, each individual paying for the treatment of his own trees. The general condition of the shade trees in both cities is much improved by this work, and considering all the trees in the streets of both cities, the results are decidedly in favor of Albany. This is probably due almost entirely to the fact that it is much more economical to take a street at a time and spray all the trees than to go hither and thither as desired by private parties. The former is possible only where the city undertakes to spray all the trees on the streets, while the latter must obtain where spraying depends upon the will and financial ability of the owner of the abutting property. It might be well to add, that as a rule Albanians neglect the trees on their own premises, while Trojans, who have spraying done, invariably include the trees on the premises as well as those in front of the property. The elm leaf-beetle has almost undisputed sway in the poorer portions of Troy, because the residents can not afford to have their trees sprayed, while in Albany these as well as those inhabited by the wealthier class are treated and the results are most beneficent, because it is in these poorer quarters that shade is most urgently needed. It therefore seems to me most advisable to urge the prosecution of such work, when necessary, upon municipalities rather than to allow it to depend upon the enterprise of private individuals, solely because it means the greatest good to the greatest number at a minimum of expenditure. This imported pest is slowly extending its range northward of Albany and Troy and in some localities where no spraying is done it is this season proving a scourge to both European and American elms.

Forest tent caterpillar (*Clisiocampa disstria* Hübn.).—This insect has been a most serious pest in New York State for the last four or five years, and in localities here and there it has proved exceedingly destructive this season. The outbreak of 1901, so far as I can learn, was much more limited in area than in the previous years and confined largely to sections adjacent to where the insect had been specially abundant previously. The caterpillar appears, as a rule, to be unable to exist in large numbers in one locality for more than four or five years in succession. This is probably to be explained by the local activity of natural enemies. Another marked feature has been the increasing predominance of the pest in orchards. It is perhaps hardly necessary to add that most of the injuries in orchards could have been prevented by timely and thorough spraying.

Carpenter moth (*Prionoxystus robiniæ* Peck).—This is a serious enemy to maple, oak, and ash trees in certain sections of New York State. Its destructive work at Ogsdenburg was brought to my attention by Miss Mary B. Sherman, of that place, and through her some interesting examples of the borers' work in sugar-maple trees were secured. One-third of a section or a tree about 15 inches in diameter was fairly riddled with the large burrows of the caterpillar of this insect. It was so abundant as to ruin a number of fine trees in that

locality and necessitate their removal. The work of this pest at Buffalo was brought to my notice by Mr. M. F. Adams, of that city, and through his kindness I have been able to secure good examples of the insects' work in ash and to observe its operations in oaks. This species also occurs on Long Island. All the examples of its work seen by me show that the full grown caterpillars prefer to run their burrows at some depth in the wood, and that as a rule they run so close to and communicate so freely with each other as to destroy the value of infested trees for timber. This insect also causes large unsightly wounds wherever its burrows come near the surface. Caterpillars about to pupate frequently take refuge in these channeled wounds, from which the pupæ work themselves partly out before the disclosure of the imago. The eggs are probably deposited in any available crevice, where they adhere to the bark rather firmly. A piece of root which had been bored by the willow curculio (*Cryptorhynchus lapathi* Linn.) was lying in a breeding cage and a female Prionoxystus embraced the opportunity to deposit six or seven eggs well within the burrow.

Apparently the females do not hesitate to oviposit before the appearance of males. Some eggs which were found in the office hatched, possibly without being fertilized, but it was impossible to prove this latter point. Dissection of a well-distended female, which probably had deposited no eggs, showed that she contained 269 well-formed ova and 133 which were partly developed, making a total of 402.

The small *Lecanium nigrofasciatum* Perg. has proved a rather serious enemy to soft maples in Albany. This scale insect has been so abundant on some small trees as to nearly cover the under surface of the limbs, and so much honeydew was exuded that the walks beneath were kept moist. The severe drain on the trees prevented much growth and resulted in the killing of a number of the smaller limbs. Badly infested twigs have a marked sour-semiputrid odor, due in all probability to the decomposition of the honeydew. Young began to appear in Albany about June 14, and by July 15 they were about 0.5 mm. long and were thickly set on the smaller twigs.

Pseudococcus aceris Geoff.—This comparatively rare species was observed in immense numbers on the bark of a hard maple at Albany, N. Y., August 6. The male cocoons were present in thousands, and in places formed large white masses on the trunk, giving a tree the appearance of being affected by a fungus. Some immature individuals were wandering over the masses of the male cocoons. The leaves were also badly affected. The cottony remains of adults were abundant, and here and there old females were still producing young, as a number of very small individuals were observed, and partly grown ones were assembled on the under surface of the leaf in long rows on both sides of the principal veins. There is a marked subacid, not

unpleasant, odor about this species when present in large numbers. It is not nearly so offensive as in the case of *Lecanium nigrofasciatum* Perg.

Chermes pinicorticis Fitch is always more or less injurious to white pines in Washington Park, Albany, but this year it has been exceptionally abundant, not only giving considerable portions of the trunks a whitewashed appearance, but literally plastering the under surface of many limbs. A number of these pines, as a consequence, have a thin foliage and are sickly.

Mr. Hopkins congratulated the author on the large number of species recorded, but he doubted that the tent caterpillar had so changed its habits as to attack pine. He was of the opinion that the occurrence of this insect upon pine was merely accidental.

Mr. Ashmead said that he also was skeptical about the occurrence of the tent caterpillar on pine, and he advised Mr. Felt to withhold that statement from publication until further investigation could be made.

Mr. Cockerell mentioned that in New Mexico the larvæ of *Clisiocampa fragilis* sometimes crawled up the pine trees and pupated among the needles, but he did not find any proof that they ate the leaves. With regard to the insect called *Pseudococcus aceris* in the Eastern States, it could not be placed in Westwood's genus *Pseudococcus*, but belonged to *Phenacoccus*. The species was almost certainly not the European *P. aceris*, but was probably American, and without a name.

The secretary read the titles of the following papers by absent members, and, upon motion of Mr. Bruner, they were accepted for publication in the Proceedings: Review of the White-Fly Investigation with Incidental Problems, by H. A. Gossard, Lake City, Fla. Hydrocyanic Acid Gas Notes, by Charles P. Lounsbury and C. W. Mally, Cape Town, South Africa. The Use of Hydrocyanic Acid Gas for Exterminating Household Insects, by W. R. Beattie, Washington, D. C. Insects of the Year in Ohio, by F. M. Webster and Wilmon Newell, Wooster, Ohio. Fruit Seriously Injured by Moths, by C. W. Mally, Cape Town, South Africa. Notes on Four Imported Pests, by A. H. Kirkland, Boston, Mass. Drought, Heat, and Insect Life, by Miss Mary E. Murtfeldt, Kirkwood, Mo.

REVIEW OF THE WHITE-FLY INVESTIGATION, WITH INCIDENTAL PROBLEMS.

By H. A. Gossard, *Lake City, Fla.*

The white fly (*Aleurodes citri*) reached its maximum of destructiveness last year, and called forth much apprehension both within the bounds of its present distribution and outside of them. About 75 per

cent of the orange groves in Manatee County are infested, and as this county puts out something like 200,000 boxes of oranges per year, worth on an average $3 per box, and since infested groves usually turn out one good crop not oftener than once in two years, and sometimes only once in three years, it is only reasonable to believe that with the insect absent the present annual yield of fruit in this county would be more than doubled. The damage to this single county alone can be hardly less than one quarter of a million dollars per year. The direct and indirect consequences of the insect's presence in the State could have amounted to but little less than one half million dollars the past year.

I believe the orange industry will flourish in spite of the fly and, barring freezes, that the restoration of our groves over middle and northern Florida will continue at a rate exceeding that of white fly dissemination, but if present conditions continue it appears that within a half dozen years our State will receive almost a million dollars less than it would with clean groves, though we do not doubt that the total income from the crop will have multiplied as many or more times than the loss during the interval. I am very sure the insect will not become worse anywhere than it was in Manatee County last year, and if groves are excellent property there at present they will remain paying holdings in said county and elsewhere, notwithstanding the presence of the fly.

Signs of alleviation from the pest have been noted for some years, but not until last year did the value of its fungous enemies become emphasized to the most casual observer as a more than decimating factor in its extraordinary numbers. By autumn disease had so reduced it that the worst infested districts are this year cleaner than they have been during any of the three seasons since coming under my observation. A visit paid to the infested territory in early July led me to recommend that the trees be left to themselves until the appearance of the September brood of larvæ, when resin wash might be applied if the fruit was becoming smutty with mold.

The fungous diseases of the insect seem well distributed throughout the State where the fly occurs, but may have been introduced by the hand of man following the coming of the fly. I have observed both the red fungus (*Aschersonia aleurodis*) and the brown fungus over all the Manatee River section, at Myers, and at Orlando. The growers usually make an effort to introduce these fungi whenever the Aleurodes appears in a new locality. The brown fungus seems more effective than the red.

Notwithstanding the mischief the white fly actually does and the dread it inspires, it is noteworthy that the earliest infested grove in south Florida on the west coast, that of C. H. Foster, of Manatee, the one mentioned in some of the very earliest literature of white fly (Insect Life, vol. 5, p. 219), and hence infested for at least ten years, is still living and vigorous, with the exception of a few trees,

and looks as if it will be able to live right on indefinitely. The interior and shaded branches, instead of dying out, as they often do, have a color, thrift, and vigor often absent in groves never found by a white fly. These trees gave a fairly good crop of oranges last year, this year promising to just about pay for the cost of maintenance. No spraying has been done or other measures of suppression taken against the insect for some years in this grove. Considering its unquestionable vitality under such circumstances and the vulnerability of white fly to parasitic and predaceous attack, it seems impossible to doubt that natural agencies other than fungi will come to the relief of the trees before their life is spent. However, I have seen trees unmistakably killed by the insect, and the interior branches very often die from its attacks.

UNRECORDED POINTS IN ITS LIFE HISTORY.

Some adult flies of the fall brood may be observed, by reliable report, in early December, all eggs hatching before the middle of that month. Nearly all the insects are in the third or fourth stage before January 1, the eggs of a few stragglers alone furnishing specimens in the first or second stage. I recall no instance at all of having observed the first stage as late as Christmas. The earliest imagos were observed upon some lemon bushes in a few very sunny and sheltered spots at Ellenton, Fla., on the 11th of February. Egg laying had already commenced at this date. The body of the spring brood, however, does not appear until in April and May. This irregularity of appearance, with the late and early dates for imagos, suggests that the late November and early December representatives belong to a straggling fourth or winter brood. Further confirmation of such a guess may be found in the marked overlapping of broods, especially noticeable in the spring. This overlapping, every possible stage of the insect being represented at the same date, may be observed in one spot, but its value as evidence of a fourth brood is somewhat diminished by the fact that the appearance of corresponding broods may vary two or three weeks in places not 20 miles apart.

A leaf of young orange, 5 inches long and 2½ inches wide in the middle, collected at Myers June 22, 1901, by careful mathematical computation had upon it upward of 20,000 eggs. While so many eggs upon so small a space is rather unusual it can not be said to be rare, for I have observed them as thickly placed many times.

SPRAYS.

Resin wash is the spray most commonly used to destroy the insect. In the hands of one who understands its use satisfactory results are almost certain to follow. If no attention at all is given the insect, the smutted fruit must be cleaned with a dampened cloth and sawdust or by some form of brush machine, the carrying qualities of the fruit being much impaired by either method. Kerosene sprays are as effective as the resin wash.

TREATMENT BY FUMIGATION.

The assistance of Prof. C. W. Woodworth, of the California Experiment Station, was secured for a month last winter, and his suggestions and experience were utilized during this period. Various styles of tents—hoop, sheet, and bell—were made ready, from 8-ounce duck or 6-ounce drilling, the cloth being mildew proofed at the tent factory. When upon the ground where they were to be used they were painted with linseed oil, into which enough lampblack was stirred to give body and color to the preparation.

Some trouble with burning of cloth was experienced, it being found to be almost impossible to paint a large bell tent without serious damage, necessitating extensive patching, unless the derrick upon which it was swung was in perfect working order and repair, so as to avoid the risk of leaving a fold in the canvas for even a short time while drying out. The weight of oiled tents is also a great objection to them. Cactus juice is not available in Florida in sufficient quantity for tent treatment and some new application must be found. A preparation used by sailors in semitropical waters has come to my attention, and I hope it is not without value. Mr. Arthur Weaver, who superintended the fumigation of Mr. A. G. Liles's grove, used the preparation and reported it lighter, tighter, cheaper, and more satisfactory in every respect than oil, with which he had had equal experience. It is said not to burn cloth and to be mildew proof. Cloth so treated and in use upon boats in Gulf waters is said to last five or six years. Such enduring quality is a very great consideration in our moist climate; and if continued experience with the recipe proves it to be as satisfactory as reported, I shall feel that one long step forward has been taken. As the recipe came to me but recently, I have not yet given it a personal test. The formula for this paint, as used by Mr. Weaver, is given in the Annual Report of Florida Experiment Station, now in the hands of the printer. The remainder of this paper, as well as much of that already given, consists in the main of almost verbatim extracts from said report.

For trees not over 12 feet high hoop tents were found to be most satisfactory. Above that to 20 feet in height I think sheet tents will prove best. Above 20 feet the bell or sheet will be most satisfactory. As one result of the work, a new pattern of derrick was devised for swinging large bell tents, which seems more flexible to varying requirements than the California patterns, or perhaps I should designate tents handled thus as box tents, for they are swung in pairs with the derrick upon the same general principle as the box tent, *i. e.*, the type of box tent described in Bulletin 122 of the California station, a derrick being substituted for the lifter. The idea that a bell tent might be handled like a box tent was due to Professor Woodworth, who mentioned it upon the day of his departure, and the practical working out of the idea was achieved by the writer's combination of ideas derived from various sources.

The main mast of the derrick is of spruce pine, about 35 feet high for trees 30 feet in height, and stands between the rows to be treated. To each side of it is attached a gaff 22 feet long, also of spruce pine. The foot of the gaff clasps the mast with arms of oak, being raised and lowered with double blocks and pulleys exactly after the manner of a ship gaff. The top of the gaff is double blocked and pulleyed to the top of the mast, so by means of its top and bottom attachments the gaff can be raised to any height, its top many feet above the top of the mast, if necessary, or it can be lowered to reach the ground. Since it can take any angle of direction also it may be quickly adjusted to trees of any height and at variable distances from the mast. The top of the bell is attached by pulley near to the end of the gaff. Three trail poles of hickory, each about 10 feet in length, are fastened to one side of the lower border of the tent, their ends being securely lashed to each other with rope, so that when they pull against each other the rope and not the cloth will catch the strain. The cloth is caught up and bagged slightly at these points of union of the trail poles, as additional protection against tearing. The center of each of these trail poles is connected with the top of the gaff by pulley, and thus the border of the tent to which they are attached may be elevated to any height, the opposite border swinging free within reach near the ground. A trail rope is attached to each of the trail poles. All pulley ropes belonging to the apparatus are secured to cleats on the mast.

In operation, when the mainmast, on rollers or wheels, has been placed in position, the height of the tree to be fumigated and its distance from the mast are noted, and the foot of the gaff is raised or lowered to the point of greatest advantage, as learned from experience. If the trees of a grove are of nearly uniform height and at regular distances apart one correct adjustment will serve for the whole grove. A similar adjustment is made of the top of the gaff, this operation by necessity being repeated with every tree. The top of the tent is next drawn fully up and then the three trail poles; the hanging free edge near the ground and as much of the border as possible is now brought into position and the top of the gaff lowered some if necessary. Slack is now given to the trail poles, and a man at each trail rope so pulls the pole to which his line is attached that the whole tent drops into position over the tree. The lower border of the tent must be extra strong to avoid tearing. It is best bound with rope. To remove the tent from the tree the procedure is almost exactly reversed. With men trained to work together the tent may be lowered over a tree in seven or eight minutes and removed in about five. Since the operation of removing the tent from one tree raises it almost in position to drop upon the next, the time required for changing will not be the sum of eight and five minutes, but the last five minutes is divided

between the two trees, removing from the one and at the same time getting almost in position to lower upon another by a quick adjustment of the angle of the gaff, it requiring less than eight minutes to cover a tree from this position. The apparatus requires four men, one of whom may be the fumigator if his chemicals have been weighed out beforehand. A gang of four can operate about four tents or two derricks. This gives forty minutes to the tree and allows ten minutes for shifting of each tent. In order to realize this expeditiousness in practice all apparatus must be in perfect working order and repair and the men trained to handling it. The results secured in my practice satisfied me that this would be a reasonable estimate, for it was done often enough in this time with our then imperfected apparatus to justify such a conclusion.

Some determinations made by Professor Miller, of the chemical department, are of interest and importance. He found that 1 ounce of sulphuric acid and 1 ounce of water, mixed and cold, when added to 1 ounce potassium cyanide yielded 428.4 cubic inches of gas; that 1 ounce of sulphuric acid and 1 ounce of water, mixed and added immediately while warm to 1 ounce of potassium cyanide, yielded 467.9 cubic inches of gas, greater by a little more than 9 per cent than with a cold mixture of water and acid. Mixing the acid and water, therefore, only as used means a saving of 6 or 7 cents per tree on large trees requiring 2 pounds of cyanide. He further determined that a greater proportion of acid did not materially alter the result, and that ammonia seems not to be formed immediately after the reaction under laboratory conditions.

A number of experiments were made with citrus twigs, orange, lemon, pomelo, etc., infested with white fly, to determine the susceptibility of the insect to the gas, dose of chemicals to use, length of time necessary, and most favorable temperature for treatment, influence of moisture present upon the leaves when fumigated, etc.

It was found that in its larval and pupal stages the insect was very readily killed by much lighter doses of gas than are commonly used against the black scale in California; in fact, the field practice with tents demonstrated that the dose could be reduced about one-half; that the time should be about forty minutes; the variation in temperature ordinarily encountered in Florida seems to be a neglectable factor; moisture did not seem to interfere greatly with the efficiency of the work unless the leaves were almost dripping, when it became a factor of much disturbance, though not so great as I had thought probable.

Trees were fumigated in the field in warm sunshine at all hours of the day, in cloudy weather, and at night. But little injury to trees or foliage was observed if fumigated at night, during cloudy weather, early in the morning, or late in the evening. Trees fumigated after 9 a. m. and

before 4 p. m. in sunshine were invariably somewhat injured, some of the younger limbs dying back and all the leaves usually shedding. The fallen leaves were all replaced by new growth in a few weeks and no permanent injury was done, but the crop upon such trees was noticeably reduced. The dropping of leaves from a tree in Florida has comparatively little significance, the trees instead of dying, as they sometimes do in California, putting on new foliage and going along as if nothing special had happened. However, the burning of limbs and injury to bloom is another matter, and therefore midday fumigation can hardly be practiced. While some defoliation occurred with trees fumigated at other times than midday, even after night, it was not strikingly noticeable nor was damage to limbs or crop of sufficient amount to be detected after a few months. Some of this work was done as late as February 18, when the blossoms were beginning to open, some of them being well expanded. The bloom seemed unaffected by the treatment unless the work was done with the sun at high meridian.

The white fly seemed practically exterminated upon the treated trees. In examining hundreds of leaves from dozens of trees about ten days after they were fumigated, and covering thousands of insects, I was able to find but a single living specimen. If a grove was segregated from all others, I have no doubt that one fumigation would render it so nearly clean that it would need no additional attention for two or three years. The great hindrance to its becoming a practicable remedy is that few groves are so isolated that the fly will not come to them from neighboring groves, and since the insect seeks young and tender growth for egg-laying purposes there is, perhaps, some tendency for it to go to trees that have been fumigated and are therefore putting out new growth. Under ordinary circumstances the insect is not a great traveler, though winged, and will often take a whole season, extending over three full broods, to spread over a 10-acre grove. Its progress will be marked by the trees showing sooty mold.

Special observations were made to determine the effect of the gas upon ladybugs. On the afternoon of January 22, 72 ladybugs, almost all *Chilocorus bivulnerus*, which had fallen to the ground under fumigation treatment, were placed in a shallow tin box and left until January 23; at 9.30 a. m. of the latter date 70 beetles were in the box, a few of them active; at 4 p. m. 66 remained in the box, about a dozen of them showing signs of activity. At 8.45 a. m. January 24 62 ladybugs were in the box, and 60 at 12.40 p. m. The 60 never exhibited signs of animation, all being observed to be dead several days afterwards. January 24, by 1 p. m., another lot of 176 fallen bugs, nearly all of the same species as before, was collected and kept in the same manner as the first ones. January 25, at 4.30 p. m., 160 of these were dead, 16 out of the lot having recovered. In the first lot 16 per cent of the whole revived; in the second lot about 9 per cent.

HYDROCYANIC ACID GAS NOTES.

By CHARLES P. LOUNSBURY and C. W. MALLY, *Capetown, South Africa.*

The submittal of these notes is prompted by the increasing employment of hydrocyanic acid gas as an insecticidal agent in closed buildings other than for the destruction of insects accompanying nursery stock. Of late we note recommendations in American rural papers for its use in dwellings to destroy bedbugs, the strengths mentioned being those ordinarily employed for scale insects. Scale insects, we have found, are exceptionally easy to destroy by the gas, and therefore our experiences in the treatment of more resistant insects and some miscellaneous tests we have made may have interest to American workers.

The gas has been regularly used during the past two and a half years to effect the destruction of vermin in the sleeping coaches on the various systems of the Cape government railways. With the adoption of this treatment, complaints from bug-bitten passengers, before very frequent, abruptly ceased. On recent inquiry it was ascertained that the railway management remains perfectly satisfied with the measure. Bugs are no longer found, but the coaches are treated once in about four months. Two 1-pound charges of 98 per cent of cyanide are used to a coach and the exposure continued from two to four hours according to the length of time available for the work. Two pounds to a coach is about equivalent to an ounce to every 80 cubic feet.

Many of the colonial jails swarm with vermin despite many methods employed to mitigate the pest. Carbolic preparations, the use of corrosive sublimate in whitewash and as a spray, the burning of sulphur, and the liberation of sulphurous acid fumes are all reported inefficient. Hydrocyanic acid gas is now coming into use as a last resort. Under our direction several jails have been treated with success, and it is understood that the government will soon have arrangements complete for a regular and systematic fumigation of all the infested premises. The personal condition of the lower-class prisoner on entering is often so indescribably filthy that continual reinfestation must be contended with; hence the expediency of regular applications of the remedy. From 1 pound of cyanide for 1,600 cubic feet to 1 pound for 1,000 cubic feet is used for jail work, the relative amount being governed to some degree by the extent of unavoidable leakage, the nature of the contents that may be harboring the pest, and the season of the year. No trouble is spared to make a space tight; particular attention is paid to the roof and in case this be of corrugated iron, as is common in the colony, the corrugations over the sills and along the ridge are stopped with plugs of burlap or plugged with clay. The higher the roof the greater is the care exercised in making it tight, thus to offset the greater upward draft of air.

Blankets and as far as possible all else that comes in contact with the prisoners are so disposed as to be most freely exposed to the action of the gas; suspension of sleeping blankets by one corner from gratings forming the floors of galleries is sometimes practicable. The exposure is continued as long as circumstances allow, with a minimum of two hours.

The procedure of the work is kept as simple as possible, and no especial difficulty is experienced in treating comparatively large spaces. A number of cells sometimes have to be treated as a unit. In one case a corridor 90 feet long, extending in cupolas to a height of 50 feet, and inclosing with its connecting cells an aggregate of 140,000 cubic feet, was treated as one space. Forty-three charges, each weighing 3 pounds, were used, and 20 of these were generated in cells off a gallery above the main floor. Five-gallon tins, in which kerosene oil has been imported, and from which the tops have been cut, are generally used for large charges. These are found safely to take 3 pounds of cyanide, and to be serviceable for two or three usages. Their recommendation is their ubiquity in this country and their inexpensiveness. As in orchard fumigation, 2 ounces by measure of water and 1 ounce by measure of sulphuric acid are used to an ounce by weight of cyanide; thus for a 3-pound charge of the latter, 3 pints (United States measure) of acid are added to 6 pints of water. When a space necessitating the employment of many generating vessels is to be treated, as was the case in doing the corridor above mentioned, the water only is measured directly into the vessels, these being then, if not before, placed in the positions desired. The acid is measured into small receptacles, as tin basins, placed within an arm's length of the vessels, and the required weight of cyanide for each, for convenience in handling laid on a square of cheese cloth, mosquito netting, or even newspaper, is also laid within reach. Squares of cheese cloth, made bag-like by tying the alternate corners, are preferred for holding the cyanide, particularly when the series of discharges to be made is a long one. When the time comes to "fire," an assistant, beginning at the farthest corner from the exit, pours the respective measure of acid into vessel after vessel, and when he has a start of half a dozen vessels the operator follows, and, with the greatest dispatch compatible with certainty in action and care to avoid splashing, drops the bags of cyanide into the steaming acid-water mixtures. Familiarity with the work, quickness of movement, and a cool head are essential to safety, and no person not possessing these qualifications should attempt multiple discharges. When the series is short the operator himself may attend to the addition of both the acid and the cyanide, and even measure the acid directly into the water. The objection to following this procedure in long series is that the acid-water mixtures may have time to cool, and therefore fail to fully react upon the cyanide, particularly the larger lumps.

We consider this hand dropping of the cyanide into vessel after vessel far safer and much more expeditious than methods of dropping which involve the use of strings manipulated from without the space. The cloth bag facilitates the dropping act, and retards but for a brief space the evolution of the gas. Curiously the cloth is sometimes practically uninjured by the chemicals.

Great care is always needed when the spaces are opened for ventilation to keep out inquisitive parties, and it is then that the responsibility of the operator is greatest. On still days the generation of heat by fires and the burning of large lamps is useful to expedite renewal of the air. The gas soon dissipates from empty rooms, but clings to bedding somewhat tenaciously; hence several hours' airing is desirable if severe headaches are to be avoided. It has been noticed that persons with weak lungs, of which there are many in some prisons among long-term convicts, suffer painful inconvenience from traces of gas unnoticed by their healthier fellow-prisoners.

The public department in charge of plague work administration has begun to make limited use of the gas for dwelling fumigation to effect the riddance of bugs, fleas, and lice. The procedure followed is the same as in jail work and the same strength of gas is used; as prolonged control over the premises can be had, the exposure is made longer, as overnight.

These various governmental uses of the gas have not been inaugurated without experimental demonstration of its efficiency. Our tests, conducted in tight spaces, have shown that much stronger gas is required to destroy bedbugs than to destroy armored scale insects. For convenience we express the strength of gas as the ratio of the number of ounces of cyanide used to the number of cubic feet in the space inclosed. Gas at a strength of 1 ounce to 450 cubic feet appears to be uniformly fatal to scale insects (*Aspidiotus aurantii*, *A. nerii*, *A. rapax*, and *Diaspis pentagona*) exposed to it for an hour, but to have little, if any, effect on bedbugs. A portion of a given number of bugs is destroyed by an hour's exposure to 1 ounce to 250 cubic feet gas; and the proportion destroyed increased with increase in the strength of the gas and the period of the exposure. Our main series of tests with bugs was made in a photographic dark room approximating 235 cubic feet in capacity. The temperature of this space varied in the different tests from 56° to 64° F. Care was taken to have nothing present that might absorb and thus weaken the gas, and only active, healthy-looking specimens of the insect were exposed. Fifteen specimens were used for each test, and these inclosed in bags of gauze suspended at mid height on the side of the room opposite where the generating vessel stood. Eight specimens survived 1 ounce to 190 cubic feet for an hour, and three, 1 to 155 for the same period, but none 1 to 155 for two hours; these effects were determined by observation extending over a week. Only three speci-

mens were recorded to survive the strength of 1 to 235 for one hour and three for 1 to 235 for two hours, but in these instances the specimens were all destroyed at the end of twenty-four hours, it not at the time being known that any might subsequently recover. In every case all of the bugs were stupefied by the gas, and none were noticed to again become active until at least two hours had elapsed. With the 1 to 150 strength for an hour, none showed signs of life at the end of five hours, but twenty hours later one could crawl and another feebly move its legs, and on the following day a third responded when probed lightly; at the end of a week the one seemed fully recovered while the others were still too weak to move about. It is evident from these tests that 1 to 155 gas for an hour is too weak for room fumigation since not all fully exposed bugs may be destroyed. It is only fair to mention, however, that in practice we have known 1 to 150 gas give seemingly perfect results in a number of instances. At other times while greatly decreasing the pest its use has not been satisfactory.

The eggs of bedbugs seem to be devitalized with the use of about the same strength of gas as is fatal to the active stages, but we have had little opportunity to make observations on this phase of the problem and therefore speak with reserve. Seven eggs laid within thirty hours of their exposure failed to hatch after treatment for two hours in 1 to 125 gas, the space in this case being a fairly tight room in a plague house and the eggs being fully exposed; nineteen eggs six days old failed to hatch after exposure for one hour in 1 to 150 gas in the dark room referred to above. Check eggs were not preserved. No eggs hatched in numbers of seemingly sound ones taken from treated railway coaches at the beginning of that work. It may seem strange that eggs should be devitalized by the gas, but in experiments conducted here three years ago it was determined that scale insect eggs (*Diaspis pentagona* and other species) succumbed to 1 to 300 gas; in fact, it was observed that eggs of a species of Dactylopius lost their vitality from an hour's exposure in the strength of gas mentioned when adults escaped death. Check lots of eggs of the different kinds exposed hatched.

The common roach (*Ectobia germanica*) succumbs to overnight treatment with 1 to 100 gas. The kitchen and scullery of one of the Cape Town clubs swarmed to an almost incredible extent with this insect. The spaces were treated with the strength intimated, and in the morning not less than a half bushel of dead roaches were swept up. About fifty that bore ootheca were boxed and brought to the office and no eggs hatched from them; there was no check test, however, to determine if such eggs would hatch were the females otherwise destroyed.

The fleas on a dog confined in a room, treated for an hour with 1 to 180 gas, were all destroyed; one hundred were removed and kept

under observation for a week to make certain that the result was as it appeared to be. Lice (*Hæmatopinus spp.*) on rats confined in the same space were also destroyed. So were several kinds of ants and the common house fly; but not one of several hundred specimens of various kinds of ticks, and only 40 out of 57 bedbugs. Ticks are the least susceptible to the gas of all the creatures we have exposed. Adult *Argas persicus*, *Amblyomma hebræum*, and *Rhipicephalus evertsi* have been exposed in large numbers to 1 to 150 gas for two hours without a single specimen manifesting injury. A score of *A. hebræum* thus treated were a month later, along with as many more fresh specimens, exposed for an hour in 1 to 80 gas, and every specimen came through this severe test seemingly more active than before. Eight long-starved *R. evertsi* exposed to this strength were much affected, 4 of them being killed and the other 4 greatly enfeebled. It may be of interest to mention that cultures of *Bacillus pestis*, the plague organism, exposed by replacing the customary cotton plug with a covering of gauze, were unaffected at this strength and in weaker strengths. This bacterium is accounted easy of destruction by ordinary disinfectants.

In the practical application of the gas we consider it advisable to remove all water and all moist substances that might absorb the gas and thus affect its efficiency by decreasing its strength. Water and meat that have been exposed to the gas should be regarded as dangerous for consumption. We purposely exposed meat and water to extremely strong gas to see if they were really rendered poisonous. Both proved quickly fatal to dogs which began to partake of them. Meat exposed and then allowed to air for a few days proved harmless. Flour exposed and afterwards made into bread was eaten by one of us with impunity.

The gas may be the most reliable agent for the destruction of insects within a confined space that we have, but in general it is a mistake to consider it an infallible eradicator. The extent to which insects in a space are protected by the character of their coverings can be determined only by experiment, and then only roughly. Individuals among scale insects in masses on their food plants resist strengths of gas far in excess of what is uniformly fatal to isolated specimens of their kind. This we have observed in the orchard and demonstrated in the laboratory. As with the adults of scale insects, so with the eggs. We have found that the eggs at the end of the large ovisac of *Icerya purchasi* are destroyed by 1 to 300 gas, while those deep in the mass remain unaffected by 1 to 200. From experience we have come to consider it inadvisable to rely on strengths of gas inferior to 1 to 100 for the destruction of bedbugs or to have the exposure less than two hours. Under exceptional circumstances even this great strength has been found untrustworthy. Active bedbugs were taken from within door casings of a jail after the surrounding space had been

exposed for three and a half hours to 1 in 90 gas, and two specimens out of seven, placed between box covers screwed together so that the insects were held but not crushed, survived two hours of treatment with 1 to 125 gas. A beam of light was visible between the boards, and the survivors were found within 3 inches of the edge. A thin covering of dry dust or earth seems a great protection. Living sow bugs and earwigs were found along with numerous dead ones on the surface dirt of the plague room mentioned above as having been treated for two hours with 1 to 125 gas. None of the creatures were in sight when the room was closed, and the presumption is that those that escaped destruction were disturbed from the rubbish on the earthen floor too late to get a lethal dose.

Grain insects have been experimented with to determine if a mass of grain was sufficiently penetrated by the gas to effect the destruction of those contained therein. A series of tests with this object in view was made in a tight glass-sided case inclosing 4.16 cubic feet of space. To insure accuracy the cyanide employed was weighed out on delicate balances. The results of the tests were most disappointing and have led to our abandonment of hopes that the gas would serve as a substitute for carbon bisulphid in the treatment of stored grain. Strengths of gas up to 1 ounce to 12 cubic feet (10 grams to the case) were found inefficient to destroy *Calandra oryza*, *C. granaria*, and other common grain insects in an exposure of forty-two hours. In the test with the strongest gas a grain bag containing about a half-bushel of refuse corn mixed with coarse mill screenings alive with the insects was exposed. The case was tight, the chemical reaction perfect, and the gas still strong at the end of the forty-two hours; yet scores of the insects escaped death. Throughout the series it was evident that the air within even small bulks of material remained harmless to the insects a short distance from the surface. The insects which crawled away from the mass and those at or very close to the surface were generally destroyed.

THE USE OF HYDROCYANIC ACID GAS FOR EXTERMINATING HOUSEHOLD INSECTS.

By W. R. Beattie, *Washington, D. C.*

With the growth of our population and the consequent crowding together of residences, the problem of the prevention and control of household insects is deserving of careful consideration from a sanitary standpoint, but one that is usually overlooked. These pests are to be found in fewer or greater numbers, both of species and individuals, in every dwelling, office, or storehouse, and no perfectly efficient means, either to prevent their gaining an entrance or to exterminate them when they are once established, has as yet been devised.

Recent successful applications of hydrocyanic-acid gas for the extermination of insects infesting greenhouse plants have suggested

the use of the same remedy for household pests. It is now no longer a theory but an established fact that 0.10 gram of 98 per cent pure cyanide of potassium volatilized in a cubic foot of space will, if allowed to remain for a period of not less than three hours, kill all roaches and similar insects.

The experiments which led to this conclusion were made in a small building which is used for laboratory purposes by the Division of Botany. This structure has for some time been infested with several insect pests, the more numerous and troublesome of which was the common cockroach (*Periplaneta americana*). The building consists of one story and basement, the upper part being rather loosely built, as it is ceiled throughout with matched lumber. This method of construction provides numerous hiding places for the insects, and also renders fumigation difficult by permitting the gas to escape too quickly. Within the building are several sources of moisture, a rather high and constant temperature is maintained in some of the rooms, and large quantities of seeds and substances that serve as food for insects are stored, making conditions well adapted to the development of cockroaches.

During the early part of last year the roaches became so numerous as to be a detriment to the work of the laboratory, and it was necessary to adopt some means of checking them. On the evening of May 10, 1900, the building was closed, and after opening up the interior of the rooms as much as possible the entire structure was fumigated experimentally with about 0.08 gram of 98 per cent pure cyanide of potassium per cubic foot of space. The gas was allowed to remain during the night, or until it gradually escaped. When the rooms were entered the following morning there remained a perceptible odor of the gas, but this soon disappeared after opening the windows and doors. The ledges and window sills were strewn with dead house-flies and the floors bore abundant evidence of the effect of the gas on roaches. Not a single insect that showed indications of remaining life was to be found in the building. About a quart of the flies and roaches was gathered up and placed in a cage, where they were allowed to remain until the following day, when two roaches showed signs of life by slow movements. These, however, could not walk when placed upon their feet, and subsequently died.

For some time after this fumigation no roaches were to be found in the building, but eventually the eggs that had been previously deposited hatched and developed, adults were carried in from other buildings, etc., until in March of the present year the roaches had again become so numerous as to be a nuisance and a detriment to the work of the laboratory. The building was again treated with cyanide gas, this time at the rate of 0.10 gram per cubic foot of space, but it was allowed to remain only fifty minutes, when the windows were opened and the gas permitted to escape. The roaches were strewn over the floors and

several mice were found dead. A large number of the roaches were again collected and kept in a cage until the following day, when it was found that fully 10 per cent of them had not been killed and were as lively as before treatment. The mice, however, showed no indications of life. The dose had been sufficiently strong, but had not been allowed to remain long enough to kill the more resistant of the roaches.

The third and most satisfactory experiment of the series was conducted on the evening of June 20, 1901, when an application of 0.10 gram per cubic foot was allowed to remain in the building overnight. On the following morning the gas had not entirely escaped, and houseflies, centipedes, spiders, cockroaches, and mice were dead, with the exception of a few roaches which had secreted themselves between the sash and frame of a loosely fitting window, and had thus secured enough pure air to prevent their being killed.

To convey an idea of the injury caused by the presence of large numbers of roaches in this laboratory, it might be stated that, frequently preceding this last fumigation, photographic plates placed on racks to dry and allowed to remain on a table for one hour were completely ruined by having films eaten from the glass; packets of seeds stored in mouse-proof tin boxes were so eaten as to allow the seeds to escape, and in many cases the seeds themselves were destroyed. Since this fumigation no inconvenience has been caused by the work of roaches or mice.

By aid of the results obtained from the above experiments, together with our present knowledge of the action of hydrocyanic-acid gas in exterminating greenhouse and scale insects, it may be stated that a dwelling, office, warehouse, or any building may be economically cleared of all pests, provided that the local conditions will permit the use of this gas. It probably would be dangerous to fumigate a building where groceries, dried fruits, meats, or prepared food materials of any kind are stored. Air containing more than 25 per cent of the gas is inflammable, therefore it would be well to put out all fire in an inclosure before fumigating. Hydrocyanic acid in all of its forms is one of the most violent poisons known, and no neglect should attend its use. There is probably no sure remedy for its effects after it has once entered the blood of any of the higher animals. When cyanide of potassium is being used it should never be allowed to come in contact with the skin, and even a slight odor of the gas should be avoided. Should the operator have any cut or break in the skin of the hands or face, it should be carefully covered with court-plaster to prevent the gas coming in contact with the flesh or the possibility of a small particle of the solid compound getting into the cut, which would cause death by poisoning within a few minutes' time.

Hydrocyanic-acid gas should not be used in closely built apartments with single walls between, as more or less of the gas will penetrate a brick wall. An inexperienced person should never use cyanide

of potassium for any purpose, and if it be found practicable to treat buildings in general for the extermination of insects the work should be done under the direction of competent officials. Our experiments have shown that a smaller dose and a shorter period of exposure are required to kill mice than for roaches and household insects generally, and it readily follows that the larger animals and human beings would be more quickly overcome than mice, since a smaller supply of pure air would be required to sustain life in mice, and small openings are more numerous than large ones.

The materials employed and the method of procedure are as follows: After ascertaining the cubic contents of the inclosure, provide a glass or stone ware (not metal) vessel of 2 to 4 gallons capacity for each 5,000 cubic feet of space to be fumigated. Distribute the jars according to the space and run a smooth cord from each jar to a common point near an outside door where they may all be fastened; support the cord above the jar by means of the back of a chair or other convenient object in such a position that when the load of cyanide of potassium is attached it will hang directly over the center of the jar. Next weigh out upon a piece of soft paper 500 grams (about 17.1 ounces) of 98 per cent pure cyanide of potassium, using a large pair of forceps for handling the lumps, wrap up and place in a paper bag, and tie to the end of the cord over the jar. After the load for each jar has been similarly provided, it is well to test the working of the cords to see that they do not catch or bind. Then remove the jar a short distance from under the load of cyanide and place in it a little more than a quart of water, to which slowly add 1½ pints of commercial sulphuric acid, stirring freely. The action of the acid will bring the temperature of the combination almost to the boiling point. Replace the jars beneath the bags of cyanide, spreading a large sheet of heavy paper on the floor to catch any acid that may possibly fly over the edge of the jar when the cyanide is dropped, or as a result of the violent chemical action which follows. Close all outside openings and open up the interior of the apartment as much as possible in order that the full strength of the gas may reach the hiding places of the insects. See that all entrances are locked or guarded on the outside to prevent persons entering, then leave the building, releasing the cords as you go. The gas will all be given off in a few minutes and should remain in the building at least three hours.

When the sulphuric acid comes in contact with the cyanide of potassium the result is the formation of sulphate of potash, which remains in the jar, and the hydrocyanic acid is liberated and escapes into the air. The chemical action is so violent as to cause a sputtering, and frequently particles of the acid are thrown over the sides of the jar. This may be prevented by supporting a sheet of stiff paper over the jar by means of a hole in the center, through which the cord supporting the cyanide of potassium is passed, so that when the cord

is released the paper will descend with the cyanide and remain at rest on the top of the jar but will not prevent the easy descent of the cyanide into the acid. The weight of this paper will in no way interfere with the escape of the gas.

At the end of the time required for fumigation the windows and doors should be opened from the outside and the gas allowed to escape before anyone enters the building. A general cleaning should follow, as the insects leave their hiding places and, dying on the floors, are easily swept up and burned. The sulphate of potash remaining in the jars is poisonous and should be immediately buried and the jars themselves filled with earth or ashes. No food that has remained during fumigation should be used, and thorough ventilation should be maintained for several hours. After one of our experiments it was noted that ice water which had remained in a closed cooler had taken up the gas and had both the odor and taste of cyanide.

For dwellings one fumigation each year would be sufficient, but for storage houses it may be necessary to make an application every three or four months to keep them entirely free from insect pests. The cost of materials for one application is about 50 cents for each 5,000 cubic feet of space to be treated. The cyanide of potassium can be purchased at about 35 cents per pound and the commercial sulphuric acid at about 4 cents per pound. The strength of the dose may be increased and the time of exposure somewhat shortened, but this increases the cost and does not do the work so thoroughly. In no case, however, should the dose exceed 0.22 gram, or remain less than one hour.

The practical application of this method of controlling household insects and pests generally is to be found in checking the advance of great numbers of some particular insect, or in eradicating them where they have become thoroughly established. This method will be found very advantageous in clearing old buildings and ships of cockroaches.

INSECTS OF THE YEAR IN OHIO.

By F. M. Webster and Wilmon Newell, *Wooster, Ohio.*

Broadly speaking, the past year has been marked by the unusual abundance of many of the more common insect pests.

During the past spring and early summer the chinch bug has done serious injury over the area which seems particularly favorable to it, viz, the country lying between the Scioto and Big Miami rivers, which section is, approximately, the most frequently and seriously affected by it. As in other years, *Sporotrichum globuliferum*, the fungus enemy of the insect, has been distributed to all that have applied, and the packages thus distributed amount to about 1,700 in number. As this fungus has been continually sent into this region since 1894, we can now state, with pretty good assurance of correctness, that the artificial introduction throughout this period has given

us no evidence of its value in protecting the country from an annual recurrence of attack when meteorological conditions are favorable to the breeding of the insect. This year, however, we have started our cultures of this fungus with affected chinch bugs collected in the fields in 1896, the material having in the meantime been kept in a tight tin box in a dry room. It can not now be said by those who know that the use of this fungus against the chinch bug is an experiment. It will work satisfactorily in wet or moderately damp weather, but will not do so when a drought is prevailing.

Owing to the fact that wheat was almost universally sown late last fall, and only the earlier sown fields were attacked by the Hessian fly, that insect has not claimed the attention this year that it did last.

Over the northern portion of Ohio little or no wheat was so badly injured last fall as to necessitate plowing under this spring, unless it was sown before September 20, 1900, and comparatively little was seriously injured, north of latitude 40°, unless sown prior to September 25, 1900. Wheat plants that had been killed last autumn by the larvæ of the fly were collected in quantity from many sections of the State and placed in the insectary in order to learn the probable condition of the fly in the fields in the spring of 1901. Only in two instances did we secure Hessian fly in great numbers. In one of these cases the wheat had been sown September 12, 1900, and the other was from the experiment plats of the Ohio Agricultural Experiment Station at Wooster. In some instances we reared myriads of the little parasite *Polygnotus hiemalis* Forbes, and the number of these left no doubt of their efficiency in checking the increase of the fly; but in some other cases we reared only very few parasites, and even less flies or none at all, so that it seems possible that there was also another unknown influence which tended to reduce the number of adult flies that emerged this spring.

The rose-chafer (*Macrodactylus subspinosus*) has not been as abundant over the State before in ten years, always in near proximity to sandy lands. It is hardly worth while to state that we have found no practical measures of suppression, but it may be stated that a mixture of 5 pounds of arsenate of lead and 50 gallons of water had no perceivable effect upon them.

Two species of Epicauta (*E. vittata* and *E. pennsylvanica*) have been unusually troublesome, and, as usually follows, a lack in the number of grasshoppers.

The strawberry weevil (*Anthonomus signatus*) worked serious depredations in the strawberry fields of Scioto and adjacent counties, fully one-half the crop having been destroyed by the pest. Information of its ravages was not received in time to permit Mr. A. F. Burgess, who was sent to investigate the outbreak, doing more than to go over the infested fields and lay plans for work next year.

The heart worm (*Hydrœcia nitela*) was reported as working considerable injury in a wheat field in the central part of the State, and a

florist in the northern part of the State complained bitterly of the ravages of the pest in his carnations set out of doors. Carnations in the experiment station greenhouses suffered severely in March from the attacks of cutworms (*Peridroma saucia*), which fed on the petals and burrowed into the unopened buds, working chiefly at night.

The Southern turkey gnat (*Simulium meridionale*) became quite abundant in Wayne County during May, causing considerable uneasiness among teams working in the fields near their breeding places. One of these places was located not far from Wooster, in a little brook fed by springs and flowing over a rocky bed. Adults were abundant May 11, and larvæ—some of them very small—and pupæ, as well as adults, were all found on the 16th of same month.

The Southern corn leaf-beetle (*Myochrous denticollis*) did not reappear in destructive abundance this year in the area where it did so much injury to young corn last year. We now know that it hibernates, in part at least, in the adult stage.

Bruchophagus funebris is widely distributed over the State, and its injuries to red clover seed are frequently reported during autumn.

The grapevine root worm (*Fidia viticida*), which was less destructive last year than it had been for some time, seems to have taken on a new vigor, and is this year again very abundant on the grape. Strangely enough, its ravages are still mostly confined to the grape region about Cleveland, extending therefrom much farther to the east than to the west. In a small nursery, near Tiffin, some 85 miles to the west, a small lot of young grapevines was attacked and the leaves very badly eaten, while in no other part of the grounds were the grapevines attacked. Arsenate of lead has not given us much satisfaction in fighting this pest, and the results of this year's experiments with this insecticide in the vineyards have not been very satisfactory, though not conclusive.

The canker worm (*Paleacrita vernata*) was present in many sections of the State in increasing numbers. There was some complaint of the inefficiency of arsenate of lead against these, but in all cases of failure investigated the spraying had been done in an inefficient manner, and the result could hardly have been otherwise than ineffectual.

The corn worm (*Heliothis armiger*) not only attacked young growing corn, but also worked in the broom corn, doing considerable damage to the latter.

The western corn root worm (*Diabrotica longicornis*), though it occurs locally eastward to the Atlantic coast, is not known as a pest east of central Ohio. Its advance across the State from the west has been observed by entomologists, and this advance throughout the corn-growing sections has been indicated in the bulletins of the experiment station. During the last nine years everyone connected with the entomological department of the station has watched carefully for the first appearance of the insect about Wooster, but not until last

year had it been observed within a distance of 50 miles. A single individual was observed last summer on a garden sunflower in the city. Twenty-five years ago, in northern Illinois, where now its ravages in the corn field are only prevented by continual crop rotation, this insect was as unusual as it is at present at Wooster, Ohio.

Early in the spring of the present year the pea louse (*Nectarophora destructor*) appeared in the clover fields throughout localities where there had been injuries to the peas last year and later spread to the fields of growing peas. In Ohio those engaged in pea culture on a large scale only plant the earlier varieties, which are picked before the insect migrates from the clover.

The harlequin cabbage bug (*Murgantia histrionica*), which was exterminated by the severe winter a few years ago, except in the extreme southern part of the State, has begun its northward spread again, and has been reported as destructive at points along the Ohio River.

Last spring a number of the egg masses of *Mantis religiosa* were received from Professor Slingerland and placed in several portions of the State, including Wooster. We have watched these continually since placing them outside, and in no instance have we been able to note the hatching of the eggs. Unfortunately some of the masses were destroyed, apparently by mice, as they were protected by wire netting that would admit nothing larger.

As a repellant against the infestation of dwellings by ants, we have used naphthaline crystals with success.

As an indication of the somewhat gregarious nature of *Limenitis disippus*, 27 larvæ were found on a group of less than half a dozen Lombardy poplars only a few inches in height. These were observed in October near Cleveland.

Chrysomphalus dictyospermi was found in considerable abundance in the station greenhouses on *Chamerops humilis*. The close superficial resemblance of this species to *Aspidiotus perniciosus* renders it of special interest at the present time.

Much has been said and written relative to the danger of spreading the San Jose scale (*Aspidiotus perniciosus*) by the shipment and sale of infested fruit. While danger is admitted by entomologists, in no instance has an introduction been traced to this source. The following experiments, by no means conclusive, will indicate that introduction by this means is beset with difficulties when we try to do it:

October 15, 1900, fresh peelings from badly infested apples were placed within 4 inches of the base of a young apple tree, set from the nursery row some four years ago. On same date peelings from badly infested apples were placed against and around the base of a small apple tree, and on the 26th more of the infested peelings were wound around the base of the same tree. July 9, 1901, as well as on previous dates, inspections made by different entomologists revealed no scale on the trees.

October 15, 1900, peelings from a very badly infested pear were placed against and around the base of a very young peach tree, and on 26th of same month these were renewed. July 9, 1901, no scale could be found on the tree.

October 15, 1900, six badly infested plums were placed 4 inches from base of a young apple tree, and two infested apples were placed in similar proximity to another young apple tree. July 9, 1901, no scale was to be found on either tree, previous inspections by others having given the same results.

October 15, 1900, six infested plums were placed against the base of a young apple tree; an infested apple was placed against the base of another tree, also young; an infested pear was placed against the base of a young peach tree, and eleven days later another infested pear was placed against the base of this last tree. Up to July 9, 1901, none of these trees carried a single San Jose scale, so far as could be learned from repeated observations by different entomologists.

As indicating the activity of San Jose scale on fruit, during the period between October 15 and November 2, 1900, the following observations are of interest: October 9, 1900, a couple of windfall apples, very badly infested by San Jose scale, were placed under observation. October 13 young scale were alive and very active on both apples; on 18th one apple was nearly decayed and many of the females were dead, five, however, remained alive and contained living young; 19th, live females and active young found on both apples; 22d, one apple decayed, the females dead, and apple discarded, the remaining apple carried living females, but no young were observed. November 2, 1900, the remaining apple carried living females, but by 16th this apple also was decayed and the scale all dead.

In this connection it must be remembered that it was only after repeated attempts to introduce the San Jose scale in the insectary, by fastening sections of badly infested limbs to young trees growing therein, that we were able to succeed. While the foregoing does not and could not prove that infestation may not originate from infested fruit, it does show the great difficulty in causing it to do so.

In all of our microscopical examinations of scale insects *Aphelinus fuscipennis* has been found but twice, in both cases in San Jose scale. *Pentilia misella* is, however, on the increase.

The plum tree mite (*Phytoptus phlœocoptes*) seems to occur generally wherever the Damson plum is grown, as it has been observed or sent from all quarters of the State. Serious damage was this year reported from Wellsville.

Trirhabda tomentosa was observed in the act of defoliating young prickly ash (*Xanthoxylum americanum*) in August, in some cases the trees dying from the effects of these beetles.

Ischyrus nigrans has been reared from a species of Agaricus. *Anthaxia viridifrons*, *Eupristocerus cogitans*, *Sinoxylon basilare*,

Dorcaschema nigrum, *Magdalis pandura*, and *M. barbita* have all been reared from hickory twigs. *Tomoderus constrictus* has been reared from the stems of *Helenium autumnale*.

Pholisora catullus has been reared from strawberry leaves in August. *Palthis angulalis*, *Blastobasis glandulella*, and the parasitic species *Elachista protœteratis* were all reared from seed cluster of sumac.

Desmia funeralis with its parasite (*Habrobracon gelechiæ*), *Pyralis costalis*, *Blastobasis glandulella*, and *Galasa rubidana* have all been reared from masses of grape leaves collected in vineyards.

Dichelia sulfureana and *Eudemis botrana* with the parasite *Bracon mellitor* were all reared from seeds of the garden sunflower.

Lophoderus velutiana, *Oxyptilus tenuidactylus*, *Exartema permundana*, and a species of Glypta have all been reared from larvæ feeding on the leaves of blackberry.

Conchylis bunteana, together with the parasite *Bracon mellitor*, were reared from seed clusters of *Vernonia noveboracensis*.

Grapholitha prunivora was reared from berries of a species of Cratægus.

Mellisopus latiferreana and *Blastobasis glandulella* were both reared from acorns.

Tischeria malifoliella and *Ornix geminatella*, with the parasite *Pimpla indagatrix*, were all reared from leaves of the apple.

A number of spraying experiments were carried out with the following results: *Swift's* arsenate of lead, 3 pounds to 50 gallons water, was applied to potato vines badly infested with *Doryphora 10-lineata*, and, though there was a heavy rainfall the night following the application, all small and medium-sized larvæ were killed, and about half of those nearly or quite full grown. Later, the same experiment was tried, but again the application was followed by a heavy rain, despite which about 75 per cent of all larvæ were killed. As against *Lina lapponica*, on willow, 3 pounds to 50 gallons water killed small and medium-sized larvæ, but did not seem to affect the older and larger larvæ. In another experiment, where 5 pounds of the arsenate of lead was used in 50 gallons of water, all larvæ were killed and the foliage was not injured.

Adler's green arsenoid gave us the following results: For *Lina lapponica*, 1 pound to 100 gallons water killed small and medium-sized larvæ, but not the larger ones, with no injury to the willows upon which they were feeding. One pound to 50 gallons killed all larvæ, and also the foliage, though the latter put out anew later in the season. On rosebushes, and against *Monostegia rosæ*, 1 pound to 150 gallons water was apparently effective and did not injure the foliage.

Comparative experiments were carried out with green arsenoid and Paris green, with the following results: One pound to 100 gallons water, and 1 pound to 150 gallons water, with and without lime, did not appear to affect either the adult Doryphora or the foliage of the

potato. The owner of one of the potato fields, however, applied green arsenoid, at the rate of 1 pound to 50 gallons water, and nearly ruined the potato vines.

Arsenate of lead has given the best results, with no injury to the foliage, while Paris green and green arsenoid give each about the same results, both being inferior to the arsenate of lead.

Experiments with whale-oil soap, Owens Standard brand, 1 pound to 2 gallons of water, had no effect on either larvæ or adult Doryphora. The same brand of soap was applied against *Diabrotica vittata*, at a strength of 1 pound of soap to 1, 2, 4, and 8 gallons of water. A mixture of 1 pound to 2 gallons of water, or weaker, did not prove successful as a repellant, while 1 pound to each gallon of water kept the beetles away, but seriously injured the cucumber plants to which the mixture was applied. One pound of this soap to 8 gallons of water was ineffective against Aphis on cherry, but the same strength completely repelled the three-lined plant-bug from chrysanthemums so that the plants were not again attacked by this insect.

Tobacco dust was ineffective against *Doryphora 10-lineata*, *Phyllotreta vittata*, and *Diabrotica vittata*.

FRUIT SERIOUSLY INJURED BY MOTHS.

By C. W. Mally, *Cape Town, South Africa.*

During May, 1900, numerous letters were received complaining of serious injury to fruit by moths, specimens of which were submitted to Mr. L. Peringuéy, assistant curator South African Museum, who determined them as *Ophiuza lienardi.*

With the exception of one specimen, this is the only species represented in the material received from the fruit growers. A summary of the correspondence has been given in the Agricultural Journal for July 5, 1900.

The moths were apparently most injurious in the East London district, serious complaints coming from East London, Komgha, Fort Jackson, Kentbury, and as far inland as Grahamstown.

It frequently occurs that a number of moths cluster on a single fruit, and some of the reports indicate that there was scarcely a fruit that was not covered with moths. One correspondent reports the moths as swarming on a load of pineapples that were being taken to market. Some idea of the seriousness of the injury may be gathered from the statement of Mr. Walter A. Edmonds, Komgha, that "20,000 extra fine oranges, on all of which, except those picked half green, directly the moths appeared, have been spoiled." Thus far injury to the following fruits has been reported: Apples, pears, plums, grapes, peaches, figs, oranges, guavas, bananas, pineapples, loquats, and medlars; also "native fruits, berries, and flowers."

The fruit growers agree as to the importance of the pest; but their observations on the habits of the adult are considerably at variance.

Some say they are nocturnal, readily attracted to lights, and easily destroyed by means of poisoned sweets. Others report observations to the contrary. The essential point seemed to be whether the moths punctured the fruit themselves or simply took advantage of some slight mutilation or an injury from some other insect, especially the fruit fly, during oviposition. There was no opportunity to make definite observations till the latter part of April, 1901. While en route to another farm, near Trapps Valley, Bathurst Division, it was convenient to stop with Mr. G. W. Smith for the night. On being asked whether he had noticed any unusual insect injury the present season, he replied that the fruit moth, though not unusual, was doing very serious damage to apples. We took a lantern and proceeded to the orchard at once. There were about 50 trees, located along a small stream, bearing a light crop of fruit. Numerous specimens of *Serrodes inara* Cram. (kindly determined by Mr. C. G. Barrett, London) were found, often from one to five on an apple, and scarcely a fruit could be found that did not show several punctures. The moths showed no signs of being disturbed by the presence of the lantern, much less attracted to it. I selected one specimen for study and placed the lantern so that every movement could be observed. The proboscis had been inserted through a very small round opening, the moth very contentedly withdrawing it till the tip was near the surface and then by moving the head back and forth rapidly laterally forced it down full length into the pulp of the fruit. This was kept up for some time. As the moth showed no signs of leaving or changing its position, I proceeded to observe numerous others and always with the same result, each one feeding quietly and continually withdrawing and inserting the proboscis. Several times a moth was seen to alight on an apple, but each time it began feeding through one of the several punctures present, which it seemed to detect instantly. A few were seen feeding through a slight mutilation or crack in the fruit. A careful examination of the proboscis and the punctures indicated that the moths were quite capable of taking care of themselves. No other insects were observed on the fruit. The following day not a moth could be seen. I examined the grass and bush along the stream without results. Soon after sundown they again put in their appearance and began feeding the same as before, gradually becoming more numerous. I kept as many under observation as possible, but they showed no intention of making fresh punctures. One specimen was finally selected and kept under continual observation. After it had been feeding for about thirty minutes it became restless and then, as if divining the cause of my devotion, deliberately moved about an inch to one side, placed the tip of its proboscis on the surface of the apple where I could see clearly that there was no opening, and began the same lateral motion of the head as before. With my hand lens I could see the two sections of the proboscis working up and down, the

tips alternately striking the surface of the fruit and gradually effecting an entrance. No sooner was the opening nicely started than the moth quickly returned to the former puncture, as if to say, "More juice and less work."

This observation confirms the published statement by C. G. Barrett, who records the observations of his sister residing in the colony. (Entomologists' Monthly Magazine, June, 1900, pp. 140–144; July, 1900, p. 163; September, 1900, pp. 207, 208; also Entomologists' Record and Journal of Variation, July 1, p. 193, and October 15, p. 267, 1900; Nature, May 31, 1900, report of meeting of Entomological Society.)

The same moth was kept under close observation from 9 to 11.30 p. m., during which time it did not leave the puncture, but fed continually.

The moths do not make a single straight channel, but force the proboscis down at different angles, thus producing a conical injury one-half inch or more in altitude, penetrated by numerous very fine channels. The tip of the proboscis is black, very hard, finely pointed, and provided with spines, which seem to serve the purpose of rasping the pulp of the fruit, thus enabling it to be drawn up with the exuding juice. The fruit in the vicinity of the puncture is very pliable. On removing the surface layer the injured portion is seen to be quite hollow.

Apples do not decay speedily, but remain for some time, the slight decay perhaps rendering them the more readily detected by the moths.

While feeding the wings were usually in a horizontal position and motionless. At other times there was a slight but distinct rapid vibration. In some cases the wings were slightly elevated, occasionally vibrating as stated above.

On one occasion an egg seemed to drop from the ovipositor. I took precautions to secure any additional ones, but obtained nothing but small drops of liquid; found no trace of the eggs. I dissected a number of females, and in one found three light green eggs, ribbed very much like those of *Heliothis armiger* Hbn., but flatter and somewhat larger.

I revisited the orchard about half an hour before daybreak and found the moths still abundant and feeding as contentedly as before. Just at dawn they gradually disappeared. I singled out four to determine their hiding place. Touching two of them with my pencil, they flitted away, it being still too dark to follow them. The third soon darted away toward the ground and was out of sight. The fourth remained some moments longer, but, unfortunately, I looked away for an instant to rest my eyes.

During the following evening I secured about 30 for specimens. Occasionally one would flit away, and I could distinctly hear it strike the ground. On lowering the lantern it was not always easy to locate them, their colors being somewhat protective. They made no effort to escape till again disturbed, sometimes permitting themselves to be

pushed into the cyanide bottle in an apparently lifeless condition, only trying to escape after the cyanide had begun to affect them.

This species (*Serrodes inara* Cram.) was only found on apples and guavas. Oranges, although ripening nicely in the same orchard, were left untouched. A few specimens of three other species, one of which attacked oranges, were also observed on apples.

To determine whether or not the moths could be readily attracted to poisoned sweets some tins of jam—strawberry, apricot, and plum—were procured and placed in some of the trees. In others the same materials were spread on sheets of paper and fastened to the branches near the fruit. With one exception not a moth paid any attention to the sweets. One opecimen was seen on the edge of the tin of plum jam, but disappeared before I could determine whether or not it was feeding.

Unless we succeed in destroying the insect in some other stage of development the only way to secure the fruit is to apply netting while the moths are abundant.

NOTES ON FOUR IMPORTED PESTS.

By A. H. Kirkland, *Boston, Mass.*

Up to the present summer Massachusetts has borne the unenviable distinction attaching to the only State harboring the gypsy moth (*Porthetria dispar* Linn). She now enjoys whatever benefit company affords misery, for during the present month a colony of the insect has been found at Providence, R. I. The infestation in this city is scattered over at least 2 square miles in the residential district. The first specimens were discovered August 1 by an amateur naturalist, Mr. Prescott Newhall, who carried them to Mr. James M. Southwick, formerly entomologist to the Rhode Island board of agriculture. Mr. Southwick rightly conjectured that they were gypsy moths, but to settle the matter beyond doubt, took specimens to the office of the Massachusetts board of agriculture, where the writer was able to corroborate the identification.

On August 2 the writer made an examination of the colony and found it in the incipient stage, no trees being defoliated. The street trees are quite generally infested, and it seems probable that the caterpillars have spread from the original centers of infestation by dropping on teams and that in this way a large part of the city may be infested.

Few facts are available at the present writing to show how the moth found its way to Providence, a distance of at least 35 miles in a direct line from the nearest infested point in Massachusetts. The colony in question does not show the characteristics of a natural infestation slowly spreading from a central point. Instead, there are several isolated points where numerous hatched egg clusters occur, none of

these clusters apparently being over 3 or 4 years old, thus showing that there are many centers of infestation.

It was most unfortunate that the work against the moth in Massachusetts incurred the enmity of a large number of discharged employees. It was well known to them that the finding of the moth outside of Massachusetts probably would cause the State to abandon the work of extermination. When the matter of continuing the work was being discussed in the legislature in 1899, a persistent rumor was in circulation to the effect that the moth had been "planted" in Rhode Island. Efforts to trace these rumors to their source were not very successful, all the available clues being followed up without tangible results. While the occurrence of the moth in Providence may be due to some well-known means of distribution, in the absence of facts showing this to be the case it is hard to avoid the belief that the moth may have been deliberately carried to that city.

The Providence city authorities have acted with commendable promptness in the matter, and under the direction of Mr. Southwick competent men are at work destroying the egg clusters with creosote oil. It is earnestly hoped that the fight against the insect will be continued in order that its future spread may be prevented.

In Massachusetts the gypsy moth has spread unchecked since the cessation of the State work against it, February 1, 1900. To those who had tried to make this work a success it was gratifying to note that in 1900 practically no damage by the moth occurred throughout the whole infested district. The former infestations had been so severely dealt with that comparatively few scattered insects remained. In some of the larger infestations, particularly in the central towns, there were enough moths to serve as nuclei for colonies, and the present year in restricted localities numbers of trees have been defoliated. The season has been favorable to the increase of the moth, and at the present date (August 15) formidable numbers of the egg clusters may be seen in all of the central towns of the infested district. It seems probable that in a few years the insect, if unmolested, will be sufficiently abundant to repeat the widespread damage caused in 1888–1890.

Already there are indications that public sentiment is becoming more favorably disposed toward the past work of the gypsy moth committee. Without doubt in a few years the increase and activity of the moth will again make necessary some organized effort to reduce its numbers.

While the cessation of the work against the gypsy moth seemed unwise, and was a great disappointment to those familiar with it, yet it is fortunate that out of this work have come accurate and effective methods of dealing with the pest when it again appears in force. The value of these methods is well illustrated in the case of the Providence infestation. Within a day after the colony was discovered a

trained man, equipped with the proper apparatus and insecticides, was placed at work destroying the egg clusters, and in a few days accomplished more than an amateur could have done in as many weeks.

While not as important in its injury to trees as the gypsy moth, few insects have created a greater local commotion than the brown-tail moth (*Euproctis chrysorrhœa* Linn.) in Boston and its suburbs the present summer. The caterpillars were sufficiently numerous to strip shade and fruit trees in many residential localities; pear trees suffering to the greatest extent, with apple, cherry, plum, and willow following in about the order named.

As is generally known, the hairs of the brown-tail moth caterpillar coming in contact with the human flesh produce a fierce and enduring irritation. As the caterpillars matured and commenced to migrate in search of shelter, large numbers of children and many adults were severely "poisoned" by them. So numerous were complaints from this source, and so prevalent was the belief that a new epidemic disease had appeared, that the Boston board of health gave a public hearing on the subject. At this hearing it was explained that the so-called epidemic was due to the caterpillar hairs, and that by the destruction of the winter webs which shelter the hibernating insects, future annoyance could be prevented. As has been determined by Mr. F. J. Smith, former chemist to the gypsy moth committee, the irritation caused by the caterpillars is probably of a mechanical nature and not due to any poisonous principle contained in the hairs. The hairs are barbed and very brittle, and when once lodged in the skin are easily broken, and require several weeks for their expulsion.

It has not been possible to continue following accurately the spread of this insect, but it is now known to occur in Brockton and in Hudson, Mass., and probably it has established itself throughout the territory lying between these localities and the known infested region, making a total infested area of over 1,200 square miles. More or less work has been done against this insect by local park and street boards, and where this has been carried on along approved lines the results have been very satisfactory.

It is noticeable that the moth is strongly attracted to lights, and hence the greatest infestation is usually where street lights are most numerous. The little European parasite, *Diglochis omnivorous* Walker, is very effective in destroying the pupæ, but its services have not been sufficient to restrict the increase of the moth.

Taking Massachusetts as a whole, the most general damage by any insect pest the past season has been that by the elm-leaf beetle (*Galerucella luteola* Muell.). This insect has now become established in nearly all of our cities and larger towns, and has finally invaded Boston, where it threatens to cause serious damage. It is noticeable

that the spread of the insect has been chiefly along water courses and to a less extent along the main lines of railway.

The severe injury by the beetle in the larger cities of the Connecticut Valley several years ago led to the introduction of municipal spraying operations. The original methods of work have been improved until they are now very effective. The chief reliance is placed upon a thorough spraying with some form of arsenate of lead as soon as the foliage develops. It has been found most practical in large operations to use several powerful hand outfits, carrying two lines of hose, rather than to employ one or two steam outfits. The greater number of outfits permits the thorough treatment of the trees in an entire city as soon as the foliage has developed, and thus the beetle is not permitted to damage the trees in one part of a city while spraying is being carried on in another section. The work of the Springfield city forester, William F. Gale, has been particularly well carried out, and has served as a model for similar operations in other municipalities.

While the beetle, as a rule, has but a single brood throughout the State, a well-defined second brood occurs on Cape Cod and a partial second brood in the Connecticut Valley. In neither locality has this latter brood caused damage worthy of note.

Willows and poplars throughout the State are becoming more and more subject to attack by the imported weevil (*Cryptorhynchus lapathi* Linn.). This insect seems also to have followed the water courses while spreading through the State, although the transportation of nursery stock is responsible for a large part of its journeyings. Nearly all our nurseries are more or less infested with this weevil, whose life history the writer has worked out in detail. Late in the summer, after feeding for some weeks on the petioles and young shoots, the beetles drill small holes into the bark beneath leaf scars or other irregularities and in them deposit the eggs singly. The holes are then carefully filled with bark dust. The eggs hatch in a short time, and the young grubs feed in the bark for a few weeks and then enter hibernation. At this time the grubs may be detected easily, as their presence is revealed by the black outlines of their burrows, which are plainly visible on the bark. With the advent of spring the weevil enters the sapwood and grows rapidly to maturity. When full grown the grub returns down the burrow, enlarging it to a uniform diameter, then ascends to the upper end, prepares a tight chamber, and transforms. The beetles commence to emerge in June. There is quite a variation in the time of emergence, those insects breeding in young shoots emerging first, while those feeding in the older wood apparently require a longer time for their development. While the insects as a rule hibernate as young larvæ, individuals in all stages of growth are sometimes found in winter in the heartwood of old trees.

In Germany this weevil is known chiefly as a pest of the basket willow

and alder. In Massachusetts we have noticed it more particularly as destroying ornamental poplars and willows. There are many localities, particularly along our coast, where cottagers are dependent almost entirely for shade upon the Balm of Gilead poplar and one or two species of willow. These trees, brittle at their best, when riddled by burrows of the weevil become easy victims of ice storms.

The remedial measures most in favor are the destruction of the grubs by hand in the fall or winter. Where a tree is badly infested it is hardly worth while to attempt to preserve it. Such trees should be cut and burned, and in their places should be planted the silver maple, three-thorned acacia, or other species, that thrive in damp localities.

DROUGHT, HEAT, AND INSECT LIFE.

By Mary E. Murtfeldt, *Kirkwood, Mo.*

Probably few localities in the Mississippi Valley have suffered so greatly from prevailing atmospheric conditions as has the suburb of Kirkwood during the present summer. Following an unusually dry spring there has been no appreciable rainfall since a brief, but heavy, shower on the 12th of June. Even of the two or three light showers that visited our city (St. Louis), but a few miles distant, scarcely a drop, or but a mere sprinkle, extended to Kirkwood. For many successive days the mercury ranged from 100° to 110° in the shade, and for only about six days since the middle of June has the maximum temperature fallen below 90°.

Under such conditions it would seem inevitable that insect life must be much affected. My personal observations, although extending over a very limited area, indicate that this is the case. Early in the spring Aphididæ of many species and in incomputable numbers occurred on grain and all varieties of fruit trees and threatened destruction to many choice ornamental shrubs. These insects would naturally be reduced as the season progressed, but usually some estivating individuals or forms can be found by the close observer. At present, however, the most careful examination fails to reveal evidence of any persisting species.

Cutworms, which were very destructive upon early vegetables in spring, find now no cultivated plants and no succulent weeds upon which to feed, nor have any species of the moths been noted for many weeks. The "corn ear-worm" or "tomato fruit-worm" of this region (*Heliothis armiger*) does not find for miles around either of these plants for its sustenance and can not, it seems to me, fail to be so reduced in numbers as to be practically innoxious for at least one or two succeeding seasons.

Curculio and codling moth, following a season in which both stone and pip fruits were practically a failure hereabout, are scarcely at all in evidence in the dwarfed and flavorless apples, pears, and peaches

that still cling to the trees or have already dropped to the hard and heated earth.

A large prune tree on the grounds of the writer which has been in bearing for eight or ten years, but which is such a bait for *Conotrachelus nenuphar* that we have seldom been able to obtain a perfect fruit, yielded recently quite a crop of undersized but not wormy prunes. As entomologists all know, the pupæ of many moths and beetles require a certain amount of moisture to enable them to emerge from the ground, beneath which their transformation takes place, and to expand their wings. It would seem as though the midsummer broods had not been able to do this, as the strongest lights have for weeks failed to attract any Noctuids, Geometers, or Bombycids, and scarcely any leaf-feeding beetles are to be found even on such vegetation as is still green. Incidentally it may be said that for the student of the life histories of insects this is the most disappointing summer on record, but what its influence may be upon many well-known forms is a matter of not a little economic interest.

The horsefly, very numerous and annoying to cattle during May and June, entirely disappeared some weeks since, the manure drying out too rapidly to afford the larvæ time to develop. Even the house fly and other annoying Muscidæ are comparatively few in number.

At this writing in this immediate locality almost the only grasshoppers to be seen in meadows and pastures are in a very immature condition, and few in number. The chorus of other orthopterous species, usually so full and obtrusive during the evening hours at this season of the year, is very thin and interrupted. Occasionally one can distinguish the soft whirring of an Orchilimum or Xiphidium, and, at remote distances and intervals, the ear-splitting shrill of the "cone head."

The true katydid does not this year interrupt conversation in the evenings on the lawn or piazza with its hoarse iterations, neither does the angular-winged form with its noisy rattle. Butterflies have disappeared with the flowers from our gardens, and bees are consuming the stores accummulated for winter use. But insects, especially the obnoxious kinds, have great and inexplicable powers of adaptation and endurance, and there is much interest attaching to the problem of their survival and multiplication under present adverse conditions.

It must not be forgotten that there are a few species that seem to revel in the heat and aridity. Among these are the ants, large and small. With no showers to inundate their galleries and temporarily arrest their activities they have increased beyond computation, and have become an almost insupportable nuisance about dwellings. The black crickets also seem to have found in the heat and drought of the present summer circumstances exactly suited to their enjoyment and multiplication. Their shrill chirpings on field and lawn and about our dwellings replace the notes of arboreal insects and indicate their presence in very unusual numbers.

Still another insect that seems to find the heat and drought of the present season most congenial and favorable for its multiplication and enjoyment is that household pest the "silver fish" (*Lepisma domestica* Pack.). Everywhere among books and papers, on closet shelves, between piled dishes, on all folded clothing and curtains containing starch the little nuisances, large and small, may be seen darting to cover upon the slightest disturbance, and in many cases the damage done is very serious, especially to costly books, collections of pictures, and to lace curtains. The only resource of the housekeeper has been to dust pyrethrum powder profusely over her books and unframed pictures, to remove all ornamental papers from the shelves of china closets and sideboards, and to frequently examine and shake out draperies and clothing liable to attack.

There are a few other species that have for brief periods proved troublesome, but those noted are the most prominent and irrepressible.

What the effects of the unusual season will be upon field-crop pests remains to be ascertained. Earlier in the season chinch bug, Hessian fly, and grain-feeding Aphididæ were very prevalent and destructive in Missouri and adjoining States, and it can only be learned by the starting of fall crops in what numbers these have survived. It is to be hoped, and may reasonably be expected, however, that the great losses in almost all crops will be, in some measure, compensated by a marked reduction in the number of destructive insects.

The secretary read several letters from absent members expressing regrets at not being able to attend the meeting, including a letter from Secretary A. L. Quaintance, who was detained on account of pressing work, and also a letter from Director William Trelease, of the Missouri Botanic Gardens, cordially inviting the Association to hold its meeting of 1903 in St. Louis during the Louisiana Purchase Exposition.

The committee on nomination proposed the following officers for the ensuing year:

President, A. D. Hopkins, Morgantown, W. Va.

First vice-president, E. P. Felt, Albany, N. Y.

Second vice-president, T. D. A. Cockerell, East Las Vegas, N. Mex.

Secretary, A. L. Quaintance, College Park, Md.

The report of the committee was accepted and the above-named officers elected.

The committee on resolutions made the following report, which was accepted and adopted:

Resolved, That this Association, at its first meeting since the death of Dr. Otto Lugger last May, desires to place upon record its deep regret at the loss it has sustained by his untimely removal. Economic entomology has been deprived of an able exponent, and the members of this association feel also that they have personally to lament a true and warm-hearted friend. Dr. Lugger has long been

identified with economic entomology in this country, and aside from his scientific ability he was a man of admirable qualities and wide information.

Resolved, That the Association of Economic Entomologists desires also to express its sense of loss through the death of Miss E. A. Ormerod, of England. Long before this body came into existence, at a time when economic entomology was ignored in England, Miss Ormerod took up the study of injurious insects, and published numerous valuable reports directing the farmers how to recognize and deal with their insect foes. She not only did this for England, but extended her researches through the aid of correspondents to the colonies, and always took a lively interest in the work done in America. As an example of private initiative and unselfish devotion to the public interest Miss Ormerod's work deserves to rank with that of Lawes and Gilbert at Rothamstead.

Resolved, That we request the Honorable Secretary of Agriculture to publish the proceedings of this meeting, and that we express to him our hearty appreciation of such action in previous years.

Resolved, That we express our thanks to the officials of the Denver High School, to the people of Denver and the local committee of the American Association for the Advancement of Science, to the Association, and to the local press for courtesies extended.

A. D. HOPKINS,
W. H. ASHMEAD,
E. D. BALL,
Committee.

On motion of Mr. Felt it was voted to hold the next annual meeting at the same place with the next annual meeting of the American Association for the Advancement of Science, on the last week day preceding and the first week day of the meeting of that Association, which will be held in Pittsburg, Pa., June 28–July 3.

Adjourned.

A. L. QUAINTANCE, *Secretary.*

LIST OF THE MEMBERS OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

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Adams, M. F., City Bank Building, Buffalo, N. Y.
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[1] Deceased.

Hon. W. Patterson

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L. O. HOWARD, Chief of Division.

PROCEEDINGS

OF THE

THIRTEENTH ANNUAL MEETING

OF THE

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1902.

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Assistant Entomologists: Th. Pergande, F. H. Chittenden, Nathan Banks.
Investigators: E. A. Schwarz, D. W. Coquillett, W. D. Hunter, C. B. Simpson.
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Assistants: R. S. Clifton, F. C. Pratt, Aug. Busck, Otto Heidemann, A. N. Caudell, J. Kotinsky.
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